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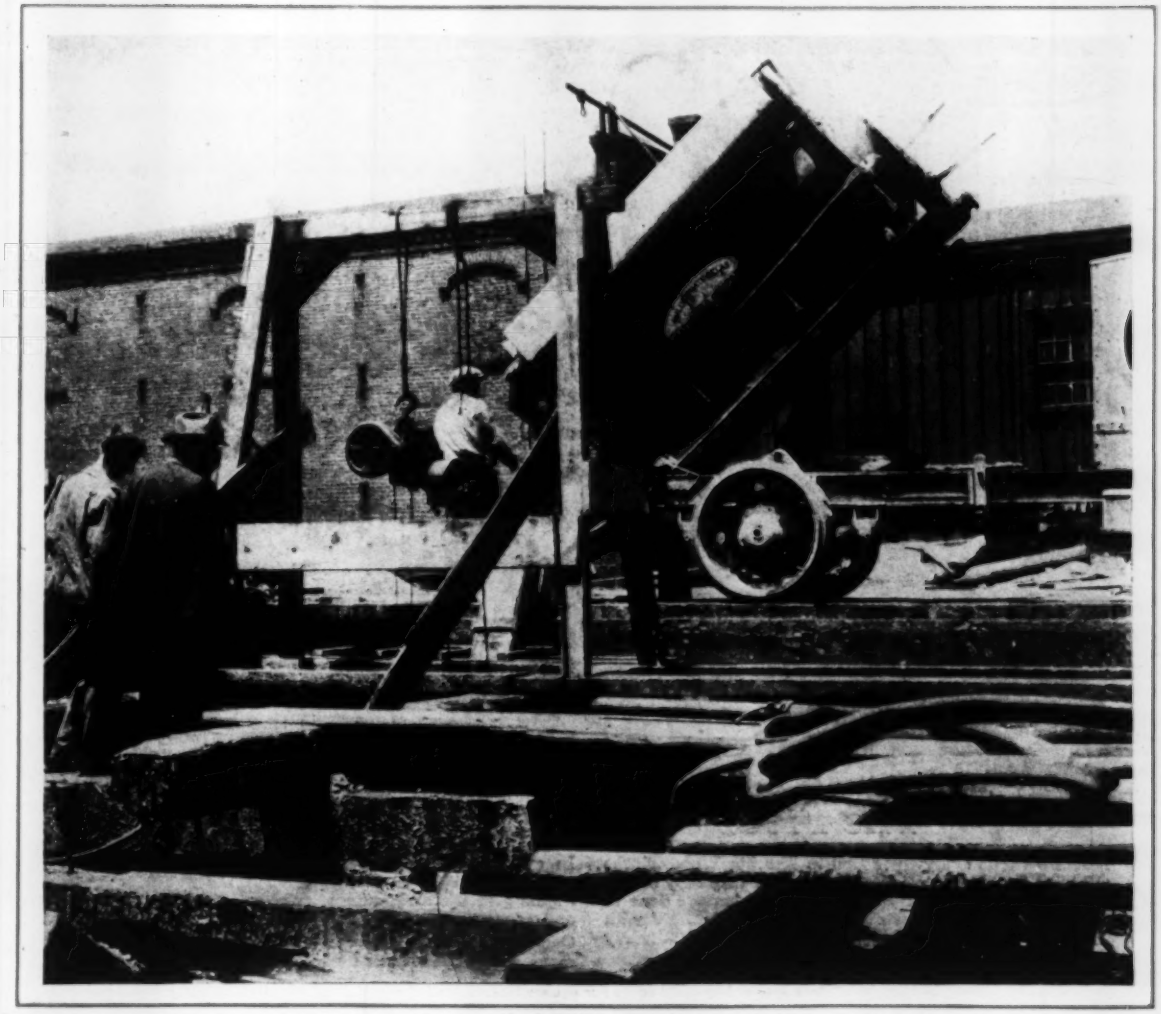

Concrete Truck Delivering Direct to Tremie on Subaqueous Construction at San Francisco

Construction of High-Level Crossing Over Hackensack River

Subaqueous Conduit Built Without Unwatering Site

Complex Concrete Building Designed for Quick Construction

Rock Asphalt Spread With a Rotating Rake

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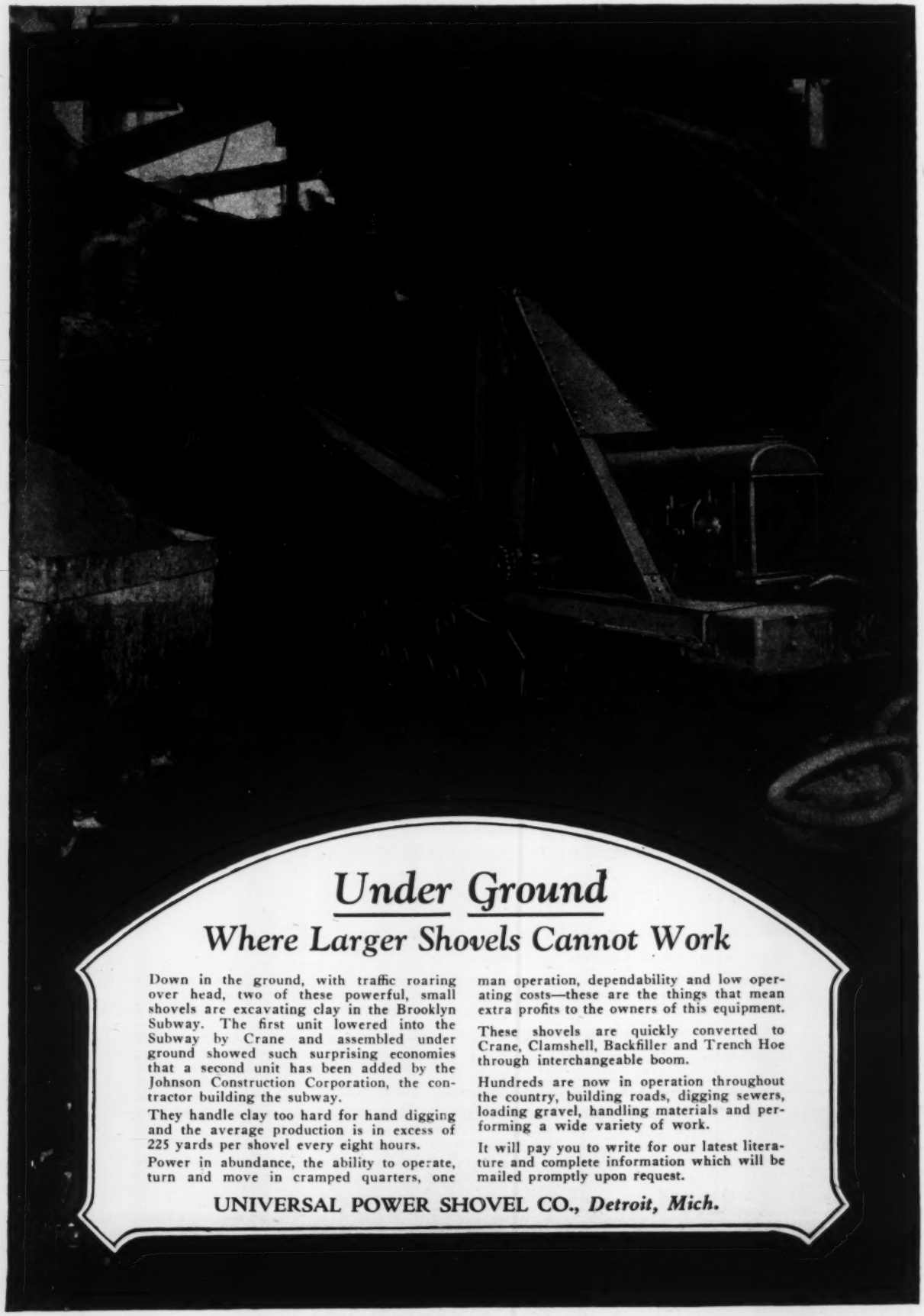

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Volume 101 NEW YORK, NOVEMBER 15, 1928 Number 20

For Greater Service

KNOWING that whatever bears on the continued strength of *Engineering News-Record* is of concern to its readers, we depart for a moment from the technical field to speak of our own affairs. The paper is henceforth to have the benefit of a more effective joining of the vigor of youth with the wisdom of age in its direction. The long-time chief and personal leader of the publishing company, James H. McGraw, has resigned its presidency, in order that, as chairman of the board, he may have fuller opportunity to devote himself to the fundamental problems of better publishing while younger shoulders bear the burden of executive routine. Malcolm Muir, for many years vice-president, succeeds him as president. The more complete organization, with its division of function, assures for the future an even closer study than heretofore of the needs of that great profession which *Engineering News-Record* serves, and more steadfast endeavor to meet those needs. To all who know Mr. McGraw's forceful and penetrating personality it is unnecessary to say that he will continue to be the prime inspiration of this endeavor; and, aided by strengthened organization, he will be an even more potent influence than in the past. There is in the change a forecast of greater service to the reader.

Express Service

POSSIBILITIES for a complete transformation of railroad express service in this country are to be found in the proposal that the railroad companies take over the operation of this service from the express companies. In recent years the parcel post has made heavy inroads into the express business and has largely transferred the handling of small parcels from the express company to the Post Office Department. That situation raises the question of a possible expansion of the express business for handling larger units. While the business remains independent of the railroad companies there are many difficulties in the way of such a change, but if it were taken over by the railroads to be operated in connection with their freight service it might be expanded to include much of the less-than-carload-lot freight now handled by the railroads. Such a change should materially relieve the railroads' present freight service, especially if used in connection with an up-to-date motor transport at terminals, and at the same time greatly improve the handling of small freight shipments.

Safety as an Asset

TWO changes are indicated by the recent announcement that automatic train control has been placed in service by our railroads on many miles of track in excess of that made mandatory by orders of the Interstate Commerce Commission issued a few years ago. The first and most important change is the acceptance by the railroad of such safety devices as an asset, and the second is the improved financial condition of the railroads, which makes it possible for them to spend money voluntarily for such purposes. When automatic train control devices were first ordered to be installed upon at least one division of each of the larger railroads of the country, the railroad companies fought the order bitterly. They argued that train control was still in the experimental stage, that costly installations might soon have to be replaced, and, worse still, that the expenditure required for the installation of train control devices would strain the limited financial resources of the companies. Moreover, many railroad officials did not believe that automatic train control had great possibilities for increasing the safety of operations. Those conditions are changed now. Financial conditions have improved, and many railroads have come to realize that the existence of whole divisions equipped with automatic train control is an asset that can be capitalized in developing passenger service.

Earthquakes and Dams

TWENTY-TWO years ago three dams along the San Andreas earthquake fault in California went through a terrific earthquake shaking without material damage. Their fortunate experience by no means proves that earthquakes may not injure or destroy dams, and there are significant facts that must be considered before drawing any general conclusions from their performance. Nevertheless, at a time when there is widespread concern about the safety of dams, and particularly when we have before us the recent instance of a large earth dam which suffered serious subsidence before storage began, it is comforting to think of the way these three old structures withstood great shocks without even springing a leak. Among the facts to be considered in reviewing these cases are that the two dams subjected to shearing by the fault movement, because located directly over the fault itself, were built of earth; that one had the advantage of having water pressure equalized on the two sides at the time of the shock, while the other was somewhat shielded from direct destructive movement because the plane of the fault passed through a slight ridge between two lengths of embankment and thus did not cut the structure itself. But as to the former, the Upper Crystal Springs dam, which was sheared by an 8-ft. offset 80 ft. from one end, there is some ground for the claim that it would have continued to store water even if it had been withstanding water pressure at the time. In the case of the Lower Crystal Springs dam, a large concrete structure that was a quarter-mile from the fault plane, the center line of the structure lies parallel to the fault, and the results might have been less creditable if the axis had been normal to the fault. Obviously, dams cannot be designed to resist earthquake movement that will shear a massive structure and move the major part

of it 8 ft. from its original position. If such seismic disturbances are to be considered, thin concrete dams and dams of any of the cellular or buttress types involve risks from which a solid earth embankment would be free. Earth dams as a type have their peculiar weaknesses, notably the danger that construction methods will not be suited to the materials used; but a well-constructed earth dam on a good foundation is one of the most stable and substantial structures that man has learned to build.

Skyscrapers Abroad

DISCUSSIONS of the high building have generally taken for granted that, since Europe would not have "skyscrapers," this modern development must be peculiarly American and in some occult way unsuited to European service. But now there is talk of a seventeen-story building in England—a good beginning in the skyscraper field for a land of five-story cities. If the project is carried out there is little reason to doubt that the economy and efficiency of the high building will shortly make themselves felt. Business habits today have no marked nationalism, and accordingly these advantages should speak as forcibly in the Old World as in the New, which means an extensive future development of high buildings over there. Since it will begin with full knowledge of the difficulties that have resulted from skyscraper growth in the United States, this development may be better guided from its very beginning, as, for example, by early adoption of regulations assuring the conservation of light and air. It would be especially fortunate if the construction of high buildings could be limited to cases where an entire block between streets is utilized for a single structure, in order to prevent the competitive growth into the sky that has been a factor in our own building history. It is quite certain that any large-scale foreign adoption of the skyscraper system will involve sufficient difference from our own practice to make it decidedly instructive to us.

A Useful Tool

TOO few engineers and contractors recognize that a pictorial record of job technique and methods as secured with a camera is equal in importance to the accepted tabular records of cash and materials. Those engineers and contractors who have learned the importance of pictures of the job are extending rather than curtailing their use of the camera. Indeed, some of them have gone so far as to adapt the movie camera to recording important working phases of their projects. The usual reason given by engineers and contractors for not using a camera is that they are too busy or that on large jobs good pictures can be had from the official photographer. Of these two reasons, if they may be rated as such, the first indicates lack of appreciation of the importance of a pictorial record and the second has the weakness that official pictures are not the property of the engineer, aside from the fact that too often they are taken for scenic effect alone, thus missing important technical and job procedure subjects. Every engineer engaged in construction work should regard a knowledge of how to operate a camera successfully as a necessary part of his training. A pictorial record of his work will take up very small space in his personal effects and will always be an asset. Owning a good, compact camera and recognizing it as one of his most useful tools should be the rule of every engineer and contractor in the field.

An Uncompleted Task

AFTER two years of discussion a committee of the American Society of Civil Engineers has just reported on the subject of a national irrigation policy. The work in which the committee engaged was a badly needed undertaking, and its efforts are therefore entitled to high commendation. The findings, moreover, are helpful and illuminating, which is the more creditable to the committee because strong differences of view had to be harmonized before agreement could be reached. But—whether because of this conflict or for other reasons—the report is far from complete. It does not constitute a statement of a national policy, nor does it even lay the groundwork for such a policy. The committee needs to continue and complete its work.

Since 1902 the nation has been carrying on irrigation development in the West, in competition with private enterprise. The conditions of the work were picturesquely varied; the results have been both strikingly good and alarmingly bad. Five years ago we depicted the situation in a series of articles and discussions, written from the intimate knowledge of a number of qualified engineers, as well as from personal observations. These discussions are applicable today, though some interesting chapters might be added to cover the developments in the lustrum. At that time it appeared that some of the good and most of the bad of federal reclamation history was attributable to the fact that it was a government undertaking: that the government through an administrative bureau had been placed in the position of real-estate developer, salesman, utility operator and mortgage holder combined, to many thousands of families. Was the policy sound? Is it sound for the future? If not, how shall it be changed? These questions are before the society's committee in its voluntary undertaking. They have not been answered.

Up to this time no thorough consideration has been given to the subject by an independent body of engineers. The subject, while in large part of agricultural and economic character, is so intimately interwoven with engineering facts and problems as to require almost necessarily an engineering analysis. Accordingly, when the irrigation division of the society initiated the study it did a peculiarly fitting thing, one which could promote the interests both of the nation and of the West in notable degree. So important an undertaking ought not be left in fragmentary condition.

Some sixteen recommendations, called "basic principles," are reported by the committee. They deal with individual items of procedure, some of them highly important, as, for example, the recommendation that interest should be charged on the land-owners' deferred payments for the irrigation construction. Yet they are only details. They do not in themselves constitute the answer to the major question of whether the government should build irrigation works at all or whether it should build such works for privately owned land; and, if so, what is the essential function of the government in such work and how should it be limited. Whether the government should subsidize the development of irrigated agriculture, and what is the most effective form of such subsidy, is equally fundamental to any national reclamation policy. Until the committee has reached a definite conclusion on these and immediately dependent questions, it cannot be said to have made an effective report on the subject before it.

We repeat what has already been suggested—namely,

that the report of the committee is constructive and deserves high praise. It does not, however, answer the basic questions which reside in the committee's avowed object of study, a national reclamation policy. Unless the study of the subject is carried to a conclusion, an engineering opportunity will be missed.

The Importance of Steel Prices

OF THE three problems confronting the steel industry—excess plant capacity, obsolete merchandising methods and unsatisfactory price structure—it is hard to choose the most pressing. Indeed, each is so interconnected with the others that collectively they constitute *the* steel problem; in the final analysis they will have to be solved as such. At the present time, however, the price question seems to be uppermost in the minds of both producers and consumers. A somewhat inarticulate discontent with fluctuating and therefore uncertain prices on the part of the structural steel fabricator is matched with an expressed dissatisfaction for the general price structure on the part of the producer. It is an anomalous situation. Producer and consumer agree that price conditions are unfavorable, but neither will take the initiative in correcting them.

As the party of the first part in any consideration of steel pricing, a greater responsibility for corrective measures probably lies with the producer. Long ago he pledged himself to an open-price policy, yet Charles M. Schwab in a recent speech before the American Iron and Steel Institute stressed the desirability of a return to "a single price open to all." Mr. Schwab's plea would be more heartening were it not so familiar. Unless and until the steel makers recognize their moral responsibility for maintaining an open price, little advancement can be made. No retail merchant of any standing would countenance any haggling over price. A piece of furniture priced at $50 will not be sold for less—not because the merchant would not be willing to take less but because he knows it would be inconsistent with his position in the community and counter to the sound economics of the furniture business. It is a sad commentary on one of our great industries when it will countenance methods on its own part that it would frown upon if practiced by its corner grocer.

What is the situation of the steel fabricator? He, too, is dissatisfied with current pricing arrangements. Theoretically able, because of the open-price policy, to know several months in advance what he can expect to pay for steel and to know constantly that his competitors will pay the same, he actually knows neither of these highly important facts. As a consequence he is forced into raw material speculation as an essential part of his business, and when his contracts result in a loss from this cause he becomes a dissatisfied and inefficient customer. Could he center his attention on production and sales he would be in a far sounder position and the steel makers would have a more efficient purveyor for their product. It is to the credit of the fabricators' organization, the American Institute of Steel Construction, that for several years it has been stressing the importance of modern merchandising of steel products in the construction industry. Yet, though they recognize that any sound merchandising plan involves the maintenance of a fair and open price, many individual fabricators aid and encourage the producer to make price concessions. Therefore, while the greater obligation for price reform may rest with the producer, the fabricator is by no means exempt from criticism and is in fact duty-bound to meet the producer at least half way.

What is the solution? As with most economic questions, it lies largely in a complete airing of views and a consequent realization of responsibilities. The steel fabricators would do well to voice their dissatisfaction publicly—to make it plain that they will abide by a fair and open price policy. The steel makers must perceive the unfavorable comparison that can be made between their industry and the ordinary retail trade and realize their need in dollars and cents for a merchandising philosophy that looks upon strict adherence to an open-price policy as not only economically sound but morally right. Since both the steel maker and the steel user have admitted that present policies are unsatisfactory, the time seems proper for a crystallization of thought on the steel-pricing question. Such a procedure could not miss being beneficial. More important, it might perhaps foreshadow the development of a merchandising plan in the steel industry comparable with its modern needs.

A Precast Concrete Record

THE seven-mile highway bridge across San Francisco Bay, whose construction was described in last week's issue, is the most notable of recent structures of precast concrete. There are in this bridge some 30,000 precast units, of which more than 7,000 are piles and deck slabs weighing from 15 to 45 tons. Its building demonstrates the sure proficiency that has been attained in molding and handling large structural units of cast concrete. It emphasizes the assurance of sound concrete given by the pretest of repeated handling. Both guarantees are of high value to the bridge engineer.

The lesson of greater significance is that the economic possibilities of precasting as a concrete construction process are a function of the facilities for handling and transporting the castings. In the operation in San Francisco Bay, as was also the case in the comparable operation carried out last year in Lake Pontchartrain, the free access by water to virtually every foot of the viaduct provided an unsurpassed means of carriage from casting yard to structure. Scowloads of castings and derrick boats for placing them could be brought to any span of the structure and to any position in relation to that span. There had to be only the simplest plant for water transportation except for the powerful derrick scows and gang piledrivers. These were expensive large tools but were nowise unique in character or purpose. Thus the great contributing factor to fast handling and carriage was not extraordinary equipment but the provision of ample equipment with unhampered freedom furnished by navigable water for equipment movement and distribution.

With an almost perfectly flexible means of distribution of cast parts, the problem of the contractor then was to route and schedule the movements of a line of barges and tugs. The means employed was the radio. The significant fact is not, however, that wireless telephony was called into service in directing construction operations; it is that perfectly scheduled loading and carriage of precast structural units was so vital a factor of speed and economy of construction that the latest invention in communication was justified. The importance of handling and carriage as demonstrated in San Francisco Bay persists in every construction operation where precast concrete is used, and cannot be forgotten in the contractor's planning.

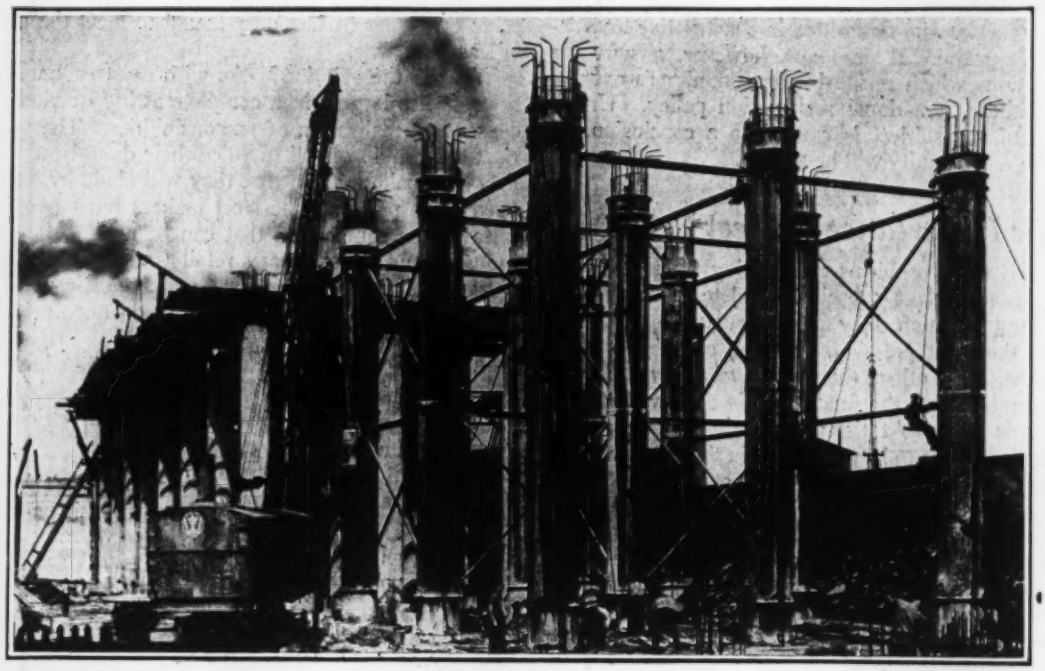


Fig. 1—Steel Column Forms and Structural Steel Beams for Slab Forms, Hackensack River Bridge, D.L.&W. R.R.

Construction of Lackawanna High-Level Crossing Over Hackensack River

Trucks Place 475,000 Cu.Yd. in Approach Fill Across Hackensack Meadows—Vertical Lift Span Erected in Place Without Interference to River Traffic—Slab Forms Supported Without Falsework

By W. H. Speirs

Assistant Engineer, Delaware, Lackawanna & Western Railway, Hoboken, N. J.

A Description of the design and purpose of the new high-level crossing over the Hackensack River at Jersey City, just completed by the Lackawanna, appeared in the *Engineering News-Record*, May 17, 1928, p. 779. The new crossing was built solely to eliminate approximately 75 per cent of the number of bridge openings by increasing the closed clearance from 12 ft. to 40 ft., thus causing less interference with the road's 200 daily trains, mostly suburban. Construction features of the bridge, approaches and a concrete box subway are described in the following article. —Editor.

MANY interesting construction features were involved in building the Lackawanna new three-track high-level crossing of the Hackensack River at Jersey City, a project totaling 1.4 miles in length and costing more than $3,000,000. Lack of space for construction operations complicated much of the work. The new three-track vertical lift bridge with a span of 205 ft. is parallel to and only 65 ft. distant, center to center, from the double-track swing bridge on the old line. During the construction of the lift span, river traffic had to be passed without interference and clearance provided for the swinging of the old bridge. Building up a 600,000-cu.yd. fill mostly with automobile dump trucks and constructing the west approaches on an underpass through the fill in the unstable part of the Hackensack meadows were difficult parts of the work. The project is now complete and traffic has been shifted to the new line. A general plan and profile of the bridge span are shown in Fig. 2.

Over the river proper the crossing consists of three deck plate girder spans, two tower spans and a vertical lift through-truss span with river clearances of 135 ft. and 40 ft. in open and closed positions, respectively. An earthfill 1,300 ft. long and a girderless, flat-slab concrete viaduct 550 ft. long, broken by one plate girder span over a street crossing constitute the east approach. The west approach is made up of an earth embankment 4,800 ft. long and a concrete viaduct 266 ft. long similar to that on the east side. In profile the crossing takes off the old main line at the extreme east end of the fill on a 0.49 per cent upgrade westward, for a distance of 0.3 of a mile, is level for 800 ft. across the river spans and descends on a 0.95 per cent grade for about 1 mile, where it strikes the old railroad grade.

The lift span will be electrically operated by direct current supplied by a motor generator operated by alternating current taken from the railroad's power line. On failure of this supply a gasoline engine-driven generator will furnish the power. As a second emergency equip-

ment a direct-connected gasoline engine will be available for mechanical operation. The time required for the maximum 95-ft. lift is 1½ minutes.

River Pier Construction—The four main river piers, *1E, 1W, 2E, 2W* (Fig. 2) were sunk to rock, 91 ft. below the water level, with pneumatic timber caissons with structural steel air chambers. No trouble was experienced in sinking the caissons except striking some of the timber grillage and riprap of two of the old piers, which required considerable work by divers to remove.

Steel sheet piling open cofferdams were used in constructing the three remaining river piers, *3E, 3W* and *4W*. Wood piling was driven inside the cofferdams for the pier foundations. To prevent any possible disturbance to the adjacent main line embankment the cofferdams were sealed with 5 ft. of concrete placed with tremies before pumping out.

All the concrete for the seven river piers was poured from a floating plant supplied by materials from barges (Fig. 4).

Approach Viaduct Construction—Along the east viaduct approach firm bearing ground was found at a depth of 10 to 20 ft. below the surface. The original meadow land on this side of the river had been filled in years ago as part of the industrial development of Jersey City. Most of the viaduct column bents on this approach and the Meadow St. retaining wall rest on 38-ft. concrete piles. The foundations for each bent consist of 56 piles, capped by a reinforced-concrete slab 11x47 ft. in area and 4 ft. thick. The caps are tied together at each end by concrete struts. On account of a dip in the firmer subsurface materials wood piling up to 75 ft. long was driven for the three bents nearest the river.

The west approach viaduct rests on timber piles 75 ft. long, excepting the four westerly bents, which are supported on circular concrete piers, 7 ft. 8 in. in diameter, extending to hardpan, a depth of approximately 70 ft. below the meadow level. This special circular pier construction was required to resist the thrust of the approach track embankment, as no abutment was built between the fill and the column viaduct because of the character of the foundation required. Each pier consists of two concrete cylinders supporting a reinforced-concrete beam 6 ft. wide and 9 ft. high on which the three columns of the viaduct bent are superimposed.

The circular piers were built by driving to refusal interlocked steel sheeting in two lengths. A crawler crane was used in setting up the sheeting and to handle the heavy steam hammer used in driving. When the sheeting had been driven to refusal, the caissons were excavated with an orange-peel bucket. The water was not pumped out, on account of the possibility of disturbing the material around the adjacent foundation piling. The concrete, amounting to approximately 120 yd. for each caisson, was placed with a covered bottom-dump bucket. The sheeting was not pulled, but the portions projecting above the top of the concrete level were burned off. Fig 3 shows the caissons after concreting.

FIG. 3—CIRCULAR PIER CAISSONS AT WEST END OF VIADUCT

Column and Slab Form Design—Several innovations in form design were used in the girderless flat slab viaduct construction. This part of the structure consists of a 22-in. concrete flat slab on three-column bents, each column 3 ft. 8 in. in diameter and about 40 ft. high. Steel forms were designed for the columns, each column unit consisting of two full length semi-cylindrical sections reinforced vertically and circumferentially with structural angles. The variation in column heights was allowed for by having the standard length of form the minimum height of column, with a few short extension sections of varying lengths up to 3 ft. Twelve sets of column forms, sufficient for four bents, were built. These could be set up in groups of six, nine or twelve and were braced with structural angle swaybracing. This bracing was adjustible, to allow the column forms to be placed in an exactly perpendicular position.

Expensive falsework necessary to support the heavy floor slab approximately 40 ft. above the ground was

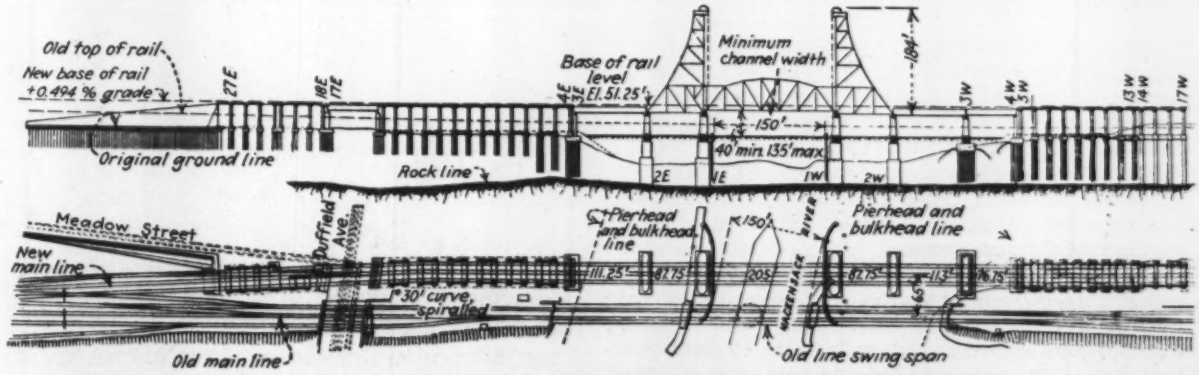


FIG. 2—PLAN AND PROFILE HACKENSACK RIVER CROSSING, D.L.&W. R.R.

FIG. 4—FLOATING CONCRETE PLANT USED IN POURING RIVER PIERS

eliminated by hanging the slab forms directly from the tops of the finished columns. This was accomplished by designing the steel column forms with a top section consisting of a structural steel channel 15 in. deep, bent circular with flanges extending outward and divided into two sections for removal. This channel ring was anchored to the concrete column by bolts cast in the concrete and was allowed to remain on the column when the remainder of the form was removed. Structural steel channels were placed on these rings, one on each side of the bent tight against the columns, cantilevered past the outside column to extend the entire width of the slab. These cross-channels were used to support 12-in. I-beam stringers placed longitudinally and extending the full distance from center to center of bent. Wood joists, 2x12 in., placed across the I-beams supported the planking which completed the forms. Joints in the forms, provided for convenience in removal, were placed transversely along the center line of bents. In removing the forms, tackles were fastened to the ends of the transverse channels which projected beyond the forms at the side of the viaduct, and, using the finished concrete slab as an anchorage, the entire form section between bents, including the supporting steel members, was lowered to the ground by a steam hoist. All side forms were removed before this lowering took place. The supporting channel rings fastened to the columns were removed by burning off the anchor bolts. This system of supporting slab forms on the permanent column construction, used frequently on other construction of similar character, was designed and patented by M. Hirschthal, concrete engineer of the Lackawanna.

Concrete Plant and Placing Methods—The reinforced-concrete approach viaducts on both sides of the river were built from material storage yards and stationary mixing plants located at both ends of the elevated structure, before the approach embankments were placed at these locations. Crawler cranes, equipped with chamshell buckets, excavated the foundations and, fitted with various lengths of booms up to 60 ft., placed all forms and falsework and handled all concrete. The concrete was handled for the most part in dump-buckets by trucks from the mixing plant to the cranes. On the west viaduct foundations, hoppers and narrow-gage cars, operated by cable from a hoisting engine, transported the concrete to the cranes over an area inaccessible to trucks. A driveway along the new work, both east and west of the river, furnished the only area available for construction and transportation purposes which was not occupied by the elevated structure. Most of the construction material, excepting for that part of the structure over the river, was received by rail and delivered to side tracks, one on either side of the river.

Pouring concrete in the columns so as to retain a uniform mixture and to insure the thorough compacting of the concrete around the spiral reinforcing required special care. Because of the small space between the spirals and forms there was no opportunity to spade thoroughly or to rod the mixture in the form. A special ½-yd. cylindrical bucket was used in placing the column concrete. This bucket was provided with a one-piece conical bottom, opening with a downward vertical movement and releasing its load slowly, thus insuring a comparatively uniform deposit over the area of the column.

SUMMARY OF QUANTITIES

Concrete piles, east approach viaduct	1,137	STEEL	Tons
Timber piles, river pier construction, east and west approach viaducts	1,168	Lift Span:	
Reinforcing steel, lb.	1,350,000	Structural steel	840
CONCRETE	Cu.Yd.	Stairways and walks	32
Lift bridge piers (4)	19,400		872
Other river piers (3)	3,000	Towers:	
East approach viaduct	6,200	Structural steel	1,287
West approach viaduct	3,800	Stairways and walks	33
Girder approach span floors	1,100	Counterweight boxes	94
Vehicle subway	1,200	Counterweight sheaves, shafts and bearings	115
James Ave. bridge, alterations to	300	Wire ropes and sockets	43
Retaining wall along Meadow Street	1,700	Rope adjustment rods, span guides, etc.	35
Total	36,700		1,607
		Operating machinery	43
		Approach girder spans	1,250
		Duffield Ave. bridge	300

FIG. 5—SLAB FORMWORK ON PLATE GIRDER SPANS
Cantilever pier shown built to clear street right-of-way.

Aggregates not exceeding ¾ in. were used in the column concrete mix. It was found that hammering the outside of the forms at the concrete level while pouring bettered considerably the surface finish of the column.

Lift-Bridge Steel Erection—All the structural steel for the lift bridge and towers was delivered to the site in barges. The towers necessarily were erected first, one lower bay on each tower being placed by a large derrick boat. The balance of the tower erection was done by a stiff-leg derrick with a 110-ft. boom mounted on a temporary falsework about two-thirds the height of the tower and occupying the rear half of the tower area. The long boom of this erecting derrick extended approximately one-half of its vertical reach above the top of the tower, permitting easy erection of the top members and cable sheaves. The hoisting engines for the derrick were located on adjacent deck girder approach spans.

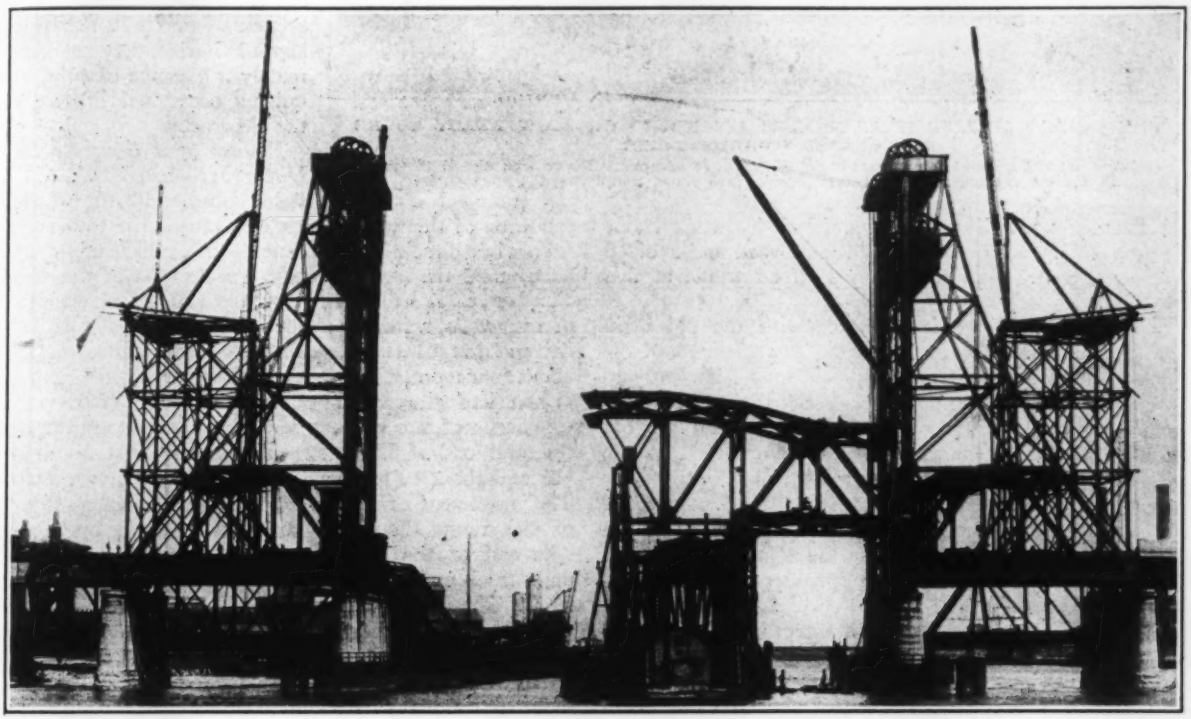


FIG. 6—ERECTION OF LIFT SPAN

Easterly two-thirds of span erected in place, above closed position to clear opening of old swing span. This part of span erected as a cantilever, resting on temporary timber pier and tied back to tower. Remaining one-third of span fabricated on a scow, floated to position and hoisted into place.

A lift span was erected at an elevation approximately 20 ft. above the closed position of the span, this elevated erection position being required to allow the swinging of the old drawbridge under the new span. The river was kept open for traffic during the erection of the lift span, excepting for one period of 72 hours. The river channel in use occupied approximately the westerly third of the channel to be provided under the new lift span, and the open position of the swing span of the old bridge over its pile protection pier occupied the middle third of the new channel, leaving only the use of the easterly third of the channel for erecting the lift span.

Erection of the first two-thirds of the span was accomplished by means of a supporting falsework pier resting on piles and located at approximately the center of the easterly two-thirds section of the span. This cantilevering of approximately half of the total span erected, as can be seen from Fig. 6, required the finished end of the span to be anchored down. The remaining one-third of the span was erected on a barge elsewhere (Fig. 7) and placed during the 72-hour period during which the river was closed to traffic. The one-third section was hoisted into place by a derrick boom mounted on the east side of the west tower. The section was fastened first at a special joint provided in the lower chord, with the free end resting on the permanent pier and with the section of upper chord over the joint in the lower chord omitted. After both sections had been placed, hydraulic jacks under the end floorbeam raised or lowered the end of the trusses to allow the omitted upper chord sections to be fitted. The placing of part of the top swaybracing between trusses and the lifting girder superimposed on end posts to which the lifting cables are attached completed the steel erection necessary before raising the lift span to the maximum height to open the river to traffic. The floor stringers and beams were placed after the span had been lifted to its maximum height by derricks.

Approach Embankment Grading—The total grading in embankment required for the approaches was approximately 700,000 cu.yd., of which 75,000 cu.yd. was placed while traffic was being changed to the new line, as the new fills could not be completed without interference with the old main track. Approximately 475,000 cu.yd. of the fill was placed by automobile trucks from miscellaneous excavations within a radius of 10 miles. The railroad had previously dumped about 150,000 cu.yd. of cinders into the meadows over part of the new line area west of the river as part of the approach embankment. The yardage placed by trucks was at a rate of 50,000 cu.yd. per month, or an average of 2,000 cu.yd. per working day. This was as much material as could

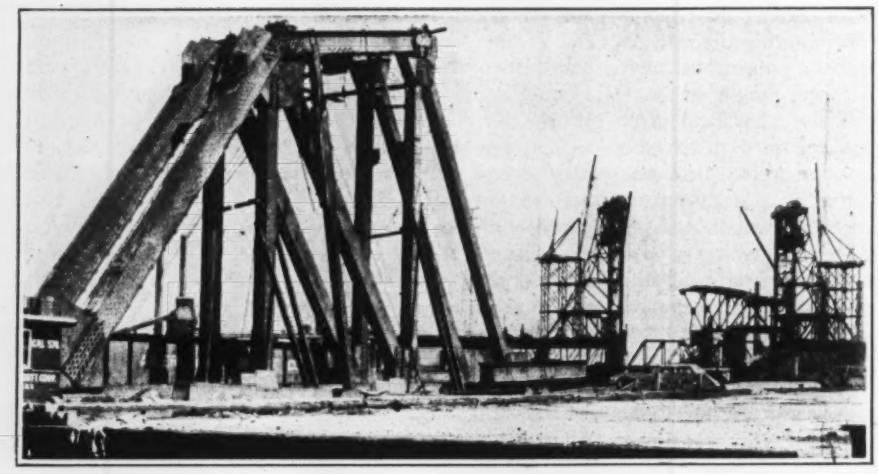


FIG. 7—PART OF LIFT SPAN TRUSSES ASSEMBLED ON SCOW READY TO BE FLOATED TO BRIDGE SITE

Background shows bridge ready to receive this part of span. River was closed to traffic 72 hours while trusses shown were hoisted into place, completing lift span trusses.

be handled under favorable conditions by work trains from a borrowpit located along the railroad and avoided the interference with the heavy railroad traffic at this location.

On account of the interference with the old main tracks, the new embankments at the extreme ends of the improvement were at first completed only sufficiently to accommodate one new track. Besides the additional filling required at the connecting points with the old main line, before the traffic could be changed to the second and third tracks, the approach embankments over practically their entire length were widened an average of 10 ft. This additional filling was brought in on dump-car trains and placed from the adjacent main track and plowed to the outside by a spreader car attached to the dump-car train.

Bearing Capacity of the Soft Meadow Mud—A study of the amount of subsidence and movement of the old and new fills placed in the soft mud of the meadows is interesting. Investigations revealed that the old main-line fill, west of the river, placed more than 40 years ago, had at no point subsided more than 15 ft. below the meadow level, although the soft mud reaches a depth of more than 30 ft. over the area investigated. The high bearing value under train loads without any further subsidence of this mattress of subsided material which has completely settled and stabilized, depending on the soft meadow mud for support, is surprising.

One side of the new track embankment rests on the old main-line fill, while the other side has nothing but the soft mud for support. On account of this uneven bearing, a rolling or tilting action of the entire mass of new filling as a unit occurred, which amounted to a sidewise movement at the top of the fill as much as 2 ft., varying with the depth of fill, which reached a maximum height of 42 ft. above the meadow level. The new fill has subsided about 10 ft. into the meadow at the outer edge of the fill, this depth decreasing toward the old embankment. The placing of the new embankment against and over the slope of the old has affected the old fill along a length of about 2,000 ft. where the new embankment is heaviest. No substantial change in grade of the old embankment along this section was noticed, but it was shoved horizontally approximately a distance of 6 in., requiring occasional shifting of the old tracks.

Failure of a Concrete Box Underpass—In contrast to the stable subsided fill, the unstable condition of the unfilled meadows caused the foundation failure of a double opening concrete box vehicle underpass, built across the new line about ¼ mile west of the river. This box, 32 ft. wide, 24 ft. high and 100 ft. long exclusive of wingwalls, rested on about 400 timber piles 75 ft. long driven through 30 ft. of soft mud. The structure was built about four months before any embankment was placed on or near it, during which period no settlement of the structure occurred, nor was any settlement noticed until nearly the total load of filling, extending about 20 ft. above the box and about 40 ft. above the meadow level, was placed. The movement of the structure that resulted in failure of the foundations was both vertical and horizontal. The end of the superstructure farthest from the old main track embankment settled a total of approximately 7½ ft. The end adjacent to the old main track, at which point the piling had been driven through part of the old fill, raised about 3 in. Of the total settlement of 7½ ft. at the one end, 1½ ft. occurred as a gradual settlement over a period of about four months, during which the structure was carrying somewhat less than the total load. Shortly after the full load of the embankment

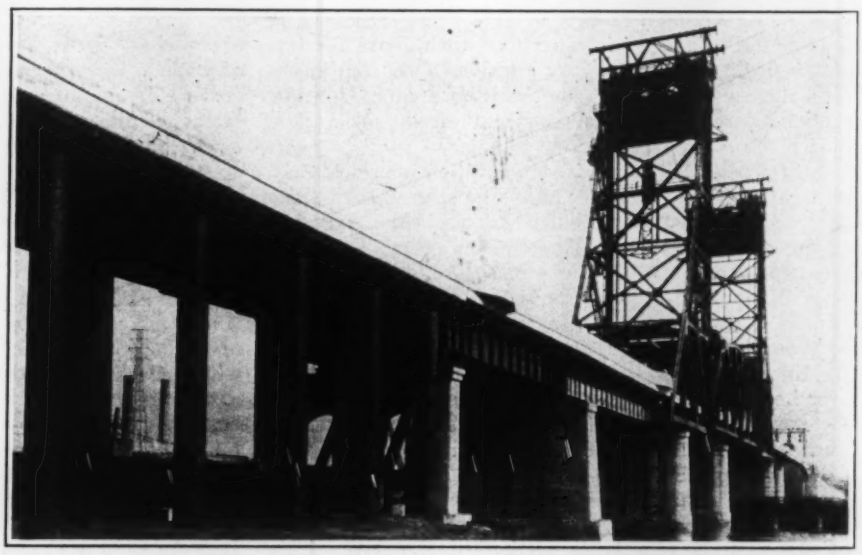


FIG. 8—WEST APPROACH VIADUCT AND GIRDER SPANS

Concrete columns have been painted with emulsified asphalt.

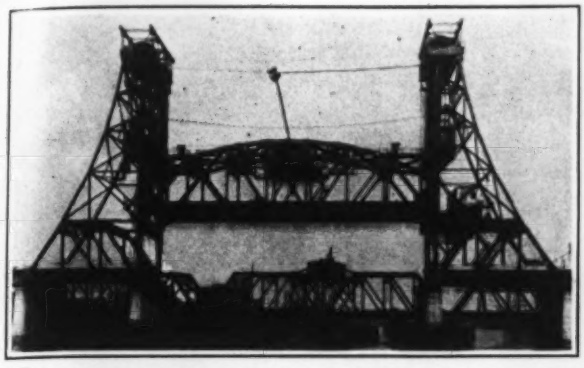


FIG. 9—COMPLETED THREE-TRACK VERTICAL LIFT SPAN
Old steam-operated swing span in background.

was placed, the foundations of the structure let go suddenly, and in three days the end had dropped approximately 4 ft., after which the rest of the settlement, amounting to about 2 ft., was gradual and extended over a period of four months. After this latter movement, the structure became completely stabilized and showed no further movement under train load. The structure was abandoned and a duplicate underpass was built about 80 ft. west of the original one. The entire concrete box during the period of movement held its shape perfectly, showing only minor cracks, which is surprising considering the abnormal stresses that the structure must have withstood. The entire structure above the horizontal construction joint in the bottom slab, which was waterproofed, moved directly endwise about 3 ft. away from the old embankment. This end movement was caused by the sidewise pull of the embankment as it subsided into the meadows. The piles, with that portion of the bottom slab below the construction joint, moved approximately 1 ft. in the same direction as the superstructure of the box. The superstructure moved 2 ft. more than the piles, sliding on the waterproofed joint. The greater portion of the sidewise movement of the piles occurred in the three-day period of rapid settlement. The absence of a subsided bed of filling material in the 30 ft. of mud permitted the movement of the piles sidewise, destroying most of their bearing value.

The second subway was built under the same conditions as the first, except that the site had been loaded by the complete embankment, which had subsided into the meadow. This fill had been in position for six months, and all settling and sidewise movement had ceased. The embankments were then excavated to the meadow level, 75-ft. piling driven and cut off at the surface. The effect on the pile penetration of the bed of subsided material was very noticeable. The piles drove very hard for the second structure, whereas no trouble has been experienced in driving the piling for the first structure. The new structure has been fully loaded and shows no settlement or other movement under train loads.

Track Construction—The railroad's most improved type of track construction was used on the new bridge and approaches, consisting of 130-lb. rail with 20-lb. tie-plates and 73-lb. tie joint plates on creosoted ties. Excepting for the lift span, on which standard timber bridge ties rest directly on the steel, the entire bridge structure will carry the standard ballasted track construction on solid reinforced-concrete floors. The use of No. 20 switches provides for high-speed train operation.

On the fills the tracks are ballasted for the present with cinders and will be raised to final grade elevation with permanent stone ballast after several months' operation has permitted any settlement of the fill to take place. To prevent scouring of the earth embankment slopes a cinder covering was used. This also added to the appearance of the slopes without resorting to expensive hand trimming. The cinders were brought in on dump cars and pushed over the edge of the bank by a spreader, more than 40,000 cu.yd. being used.

Construction of the project was begun in March, 1927, and was completed in October, 1928, requiring a total of about twenty months. The approximate time required to execute the important parts of the work is as follows: Construction of river piers, six months; erection of lift bridge steel, ten months; construction of approach viaducts and approach deck spans, twelve months; embankment grading, eleven months; track construction, four months.

Engineers and Contractors—The design and construction of the project were under the direct supervision of G. J. Ray, chief engineer of the railroad. Directly connected with the work for the railroad were H. M. Warren, electrical engineer; A. J. Neafie, principal assistant engineer; H. M. Doughty, division engineer; J. L. Vogel, bridge engineer, M. Hirschthal, concrete engineer; J. E. Saunders, signal engineer, and W. H. Speirs, resident engineer. Waddell & Hardesty were consulting engineers on the lift bridge. The contractors were as follows: American Bridge Company, structural steel; the Foundation Company, river piers; H. F. Curtis, approach viaducts and grading; Raymond Concrete Pile Company, concrete piles. The railroad company did all track and signal work, erected the approach span girders and took care of all temporary work. The dismantling of the old line, including the old bridge, is being done by the railroad company.

Rotating Rake on Finishing Machine Spreads Rock Asphalt

Rock Asphalt Laid Cold, Broken Down and Spread Evenly by Finishing Machine Used on Concrete Base

By John L. Hubbard
John L. Hubbard Construction Company, Knoxville, Tenn.

A STANDARD concrete-finishing machine, with an added raking device, is being used in constructing a 9-mile pavement of rock asphalt on a concrete base in Cheatham County, Tennessee. Similar machines have been used to spread hot-mix asphalt, but this is the first time one has been used to spread natural rock asphalt laid cold. The asphalt is being laid on a 7-5-7-in. (parabolic curve) concrete base, with a 1¼x6-in. curb on each edge. The base, too, is finished smooth and a paint coat is applied ahead of the asphalt.

The rock asphalt is dumped in piles on the base ahead of the finishing machine as shown by Fig. 1. Men with shovels then roughly spread the piles, throwing the material back in front of the rake as shown by Fig. 2. It then contains many lumps, and the purpose of the rake is to break these down, even up the asphalt layer and provide a fine, homogeneous material ahead of the finishing machine screed. Except for the added raking

device, the machine is of standard construction in every respect.

As shown by Fig. 2, a revolving rake is supported by a separate carriage, which is connected loosely to the finishing machine proper. The shaft is driven from the finisher by a sprocket and chain and is rotated at a relatively high speed. The teeth are set in spirals along and around the shaft so as to reach practically every portion of the roadway width. Both the rake carriage and the finishing machine run on the curbs. In finishing, the shoes of the screed are set so that the screed finishes the asphalt ½ in. high to allow compression by the roller. Referring to Fig. 2, the piling up of the asphalt ahead of the screed is to be observed. Its fineness and freedom from lumps compared with the material ahead of the rake is also to be noticed. In Fig. 1 the asphalt as spread by the screed is shown. This illustration also shows the whole gang of nine men required to spread and finish the asphalt ready for rolling.

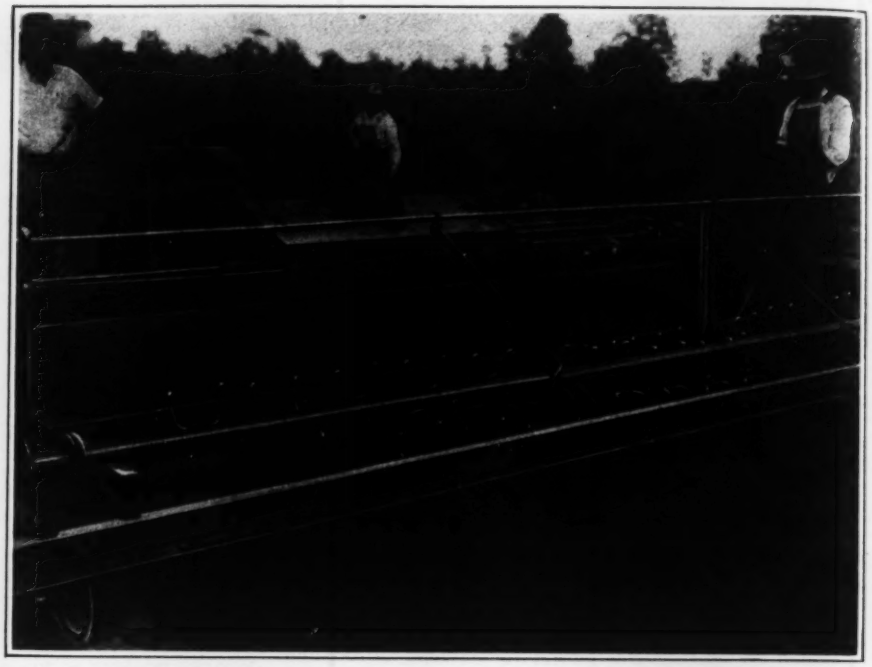


FIG. 2—CLOSE VIEW OF ROTATING RAKE ATTACHMENT TO FINISHING MACHINE

This machine finishing is found to have several advantages. It gives a uniform yield in square yards per ton; less than 0.1 sq.yd. per ton variation has been shown. The output compared with raking by hand is about doubled. There is less supervision required by the inspector to make certain that the proper amount of material is being got into the spreads at all times. The labor cost is cut down; besides the foreman and finishing machine operator, there are only nine men. With this gang an average of 3,000 sq.yd. a day is being this gang an average of 3,000 sq.yd. a day is surfaced.

The work is being carried out by the writer's firm as contractor for the state highway department, whose engineers have expressed appreciation of the exact and satisfactory work of the finishing machine.

Standardization Making Big Strides in Britain

At the tenth annual meeting of the British Engineering Standards Association, recently held in London, the report of the association's 27th year of activity was presented, in which it was recounted that 568 committee meetings had been held during the year. Since the last report 105 new and revised specifications have been issued, as against 57 in the previous year. The demand for standardization in industry continues to be much greater than the means at the association's disposal permit it to cope with, but its resources are growing, and considerable headway is being made with a scheme of standardization to cover the entire empire.

The attempt at international standardization has been dropped, although the association announces that it is always ready to co-operate with foreign societies and is doing so where a general agreement appears possible.

FIG. 1—ROCK ASPHALT SPREAD WITH CONCRETE-FINISHING MACHINE

Widening a Heavy-Traffic Street in St. Louis

Olive St. Widened by a 40-Ft. Strip for 2 Miles—Wrecking and Paving Methods—Rapid Construction—Revision of Car Tracks and Public Utilities

By W. W. Horner
Chief Engineer of Sewers and Paving, Board of Public Service, St. Louis

FIG. 1—OLIVE ST. AS WIDENED, LOOKING WEST FROM TWELFTH ST.

THE throwing open to traffic on July 10 of the 2-mile widened portion of Olive St., at St. Louis Mo., brought to conclusion the procedure for a major thoroughfare development unique in the number and length of legal and technical delays and presenting an unusual contrast with these delays in the remarkably rapid construction program achieved. Various causes combined in deferring the consummation of this project for 8½ years after the first official step was taken. The character and extent of the widening are indicated by Fig. 2, while Fig. 1 shows the completed work at the same location.

In 1917, the widening of this street from 60 ft. to 100 ft. was proposed by the city plan commission to facilitate traffic movements westwardly from the business district and to help re-establish property values in the so-called blighted area. It involved the taking of a 40-ft. strip of private property on the south side of the old 60-ft. street for a distance of 2 miles, from Twelfth St., the principal wide thoroughfare of the business district, to Channing Ave., where it merges into Lindell Boulevard, the principal thoroughfare of the western part of the city, as shown in Fig. 3.

As this proposal was opposed by property owners, it remained dormant until 1919, when their opinion changed. The condemnation and subsequent legal procedure and delays occupied a period of 6½ years; the paving procedure and testing of charter amendments consumed 1½ years more, while the effective paving procedure then required only three months and the construction time was only 5½ months (March-July, 1928).

Preliminary Paving Procedure—By the time the condemnation had been completed, property owners had become exasperated with the delay, much property had changed hands, speculative values developed, and the situation bade fair to discredit major thoroughfare planning. The city administration hoped to carry out the reconstruction quickly, and while the first of the old buildings were being demolished, in June, 1926, an ordinance was introduced initiating the first paving proposal.

As the cost of condemnation had been spread very widely over the central western part of the city, it was felt that the improvement might reasonably provide better transit facilities from that section. The surface line on Olive St. had for years carried the heaviest traffic in the city, and it was proposed to speed up this trolley movement by placing the new tracks within a curbed neutral strip and by radically reducing the number of stops. The first paving procedure, therefore, provided for two 12-ft. sidewalks, two 26½-ft. roadways and a 23-ft. neutral strip. Many owners, however, advocated a full-width roadway, and the above-mentioned plan was finally rejected by the Board of Aldermen in January, 1927, after a delay of eight months.

New proceedings were at once started for paving the roadway from curb to curb, and under the cumbersome procedure required by the existing charter they were carried through to the point of receiving bids in August, 1927. In April, 1927, however, the city charter had been amended by a popular vote, the amendments having been

drawn by the city's engineering department in an effort to reduce the time required for preliminaries in special assessment work. On the passage of these amendments the third paving procedure was started and was completed in one month (in June, 1927). Contracts were awarded on Aug. 1. At this point the banks, facing the problem of handling $5,000,000 in special assessment tax bills under a newly enacted charter provision, decided not to purchase the bonds until the constitutionality of these amendments had been upheld by the courts. Accordingly a restraining order was secured on Aug. 12, and work involving the issuance of special assessments was stopped.

Removal of buildings was completed, but the wreckage remained on the 40-ft. strip and new structures could not be occupied to advantage. Finally the administration secured a modification of the restraining order and was permitted to proceed with the expenditure of the bond-issue money, but not with any of the work involving assessment. The contract was accordingly modified and the grading of the 40-ft. strip, with the curbing on that side of the street and a strip of sidewalk paving, was carried out with unusual rapidity between Sept. 29 and Dec. 1, 1927, at a cost of about $60,000. It may be explained that all major thoroughfare projects are financed in part at the expense of the city at large. For Olive St., 45 per cent of the cost was paid from the $87,000,000 bond issue and the remaining 55 per cent through special assessment. It was understood that the bond money would pay for grading, curbing and foundation, the assessment covering principally the wearing surface.

On March 17, 1928, the State Supreme Court decided favorably on the validity of the charter amendments and dismissed the restraining order. Three days later the contractor was able to start with a full organization, unrestricted for the first time. Within two months the south side of the street had been completed, and on July 10 the whole project was finished and turned over to traffic. Considering the amount of detail work to be done, this constituted a remarkable construction record and a pleasing contrast to the long years of litigation and delay. The final cost of the work was $325,665, of which $14,275 was paid through refunds for the old granite block used, $140,110 was paid from the bond issue and $171,280 was assessed against the adjoining property. This assessment amounted to about $12 per front foot, or very little more than the average cost of a minor pavement.

Paving Construction—The old 36-ft. roadway had rough granite block on a heavy sand bed over an old concrete foundation. The curb was of limestone, badly disintegrated. The improvement involved the paving of the 76-ft. roadway, with the street-car tracks removed to the center; the junking of the old curb, the setting of new granite curb, the laying of a new and heavy concrete foundation, the construction of granite block gutters 8 ft. wide and the paving of the remaining surface with 3-in. sheet asphalt. The relation of the new to the old pavement is shown in Fig. 4.

The wide gutter areas are due to the policy not to place sheet asphalt under parked vehicles; granite was used because it was available in the old pavement and could be recut at relatively small cost. The contractor's price for this granite surface, including 6-in. concrete foundation and asphalt mastic filler, was $4.60 per square yard. But he also refunded to the city, for the old

FIG. 2—WIDENING OLIVE ST., ST. LOUIS, MO., LOOKING WEST FROM TWELFTH ST.

granite block taken up, 75c. per square yard on a much greater yardage than was involved in the gutters.

On the widened area the new 9-in. concrete foundation with its 3-in. asphalt gave the same thickness as the granite block with its 6-in. foundation. On the opposite side of the street the new pavement lay in part over the old concrete foundation and in part over the heavy concrete base of the old tracks. Here the new base averaged about 6 in. of new concrete on top of 6 in. of old low-grade concrete in the former street area and on top of 8 to 20 in. of concrete on the old street-railway area. This concrete was paid for by the cubic yard. As it was not practicable to measure the yardage in the job, the contract stipulated a payment for 6½ cu.ft. of concrete per sack of cement used. As the concrete came from a central mixing plant where all ingredients were accurately controlled, the volume of concrete per sack of cement could vary only slightly.

Wrecking of Buildings—While the work was held up in court, removal of buildings was allowed to proceed

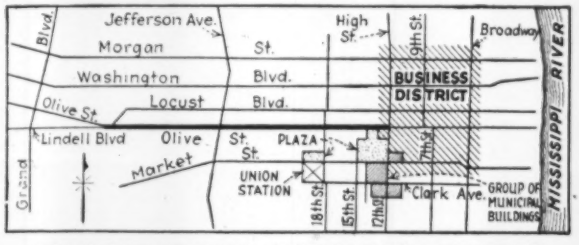


FIG. 3—RELATION OF OLIVE ST. TO STREET PLAN

slowly. Many of these were two- and three-story brick dwelling houses or stores 30 to 40 years old. Those located mainly on the 40-ft. strip were completely torn down. Larger buildings were revised by cutting off the front and building a new façade. In a few instances the owners chose to move the buildings back. For the only large modern building, the Fruin-Colnon Construction Company, as contractor for the owner, cut entirely through the building a slot sufficiently wide to permit the building of a new front, after which the detached part of the structure was wrecked.

Filling Basements—The city's engineering department took control of the cellar fills, as settlement under earlier widening projects had demonstrated the necessity of a stable foundation in these areas. At first the owners were permitted to fill the cellars with building débris, excluding perishable material such as wood, sheet metal and roofing paper. Care was taken that where brickbats or coarse stone were deposited, sufficient small material was used to fill the voids. Where this débris was not sufficient, the owner was permitted to level off the filling with earth, the department undertaking to aid settlement by flooding. While this produced considerable settlement, the subsequent drying and shrinkage were slow and unsatisfactory.

In January, 1927, when it appeared that the paving would be carried out during the summer, further use of dirt or clay filling was prohibited. An active inspector in charge permitted owners to fill with building débris of the proper character, sought out other materials of this type in the general neighborhood, offered a free dump for it, supervised its use and also arranged for the filling of large areas with broken concrete, waste macadam, granite spalls and sand from the reconstruction of other old granite-paved streets. Contractors were generally glad to secure the short haul for disposition of such material and were willing to go to the expense of boarding over sidewalks and keeping dump men on the work. In this manner the filling of the remaining cellars was completed during the summer of 1927.

When the rough grading operation was carried through in the fall of that year and more particularly when the shaping was done in the spring of 1928, the value of this supervised filling with hard material became evident. All high-grade filling was carried out without expense to the city, except for the time of the inspector.

Revision of Utility Properties—In the new location of the street railway, one track was in the old gutter space and one on the sidewalk space. The former covered several pipe and conduit structures. Rather than remove an extensive telephone conduit directly under the track, the owner built new gooseneck manholes consisting of the chamber under the track, an outlet section and a manhole head immediately adjacent. Some of the pipes were left under the track area. Others were removed, in some instances to an alley, as the utilities' engineers were generally unconvinced of the stability of the filling in the cellar areas and in some instances were appalled at the difficulty of trenching through the stone and brick fills.

In the spring of 1928 the street-railway company began to reconstruct its track. A detour track was laid on the north side of the street, leaving the old south track for a work track. After the new south track was completed, the extreme north and south tracks were operated while the second new track was built. When it became known that the work would be delayed through court proceedings, the company repaved with granite blocks temporarily between the old and the new pairs of tracks. Operation was then carried out over the north old track and north new track, the remaining old track having been put out of service on account of construction of conduit manholes and the new south track being left idle for the better safety of the contractor's employees.

Expensive reconstruction was also required by the city's sewer and water departments. While no figures are available, it seems probable that the cost of revising utility and city properties in this street must have approached the actual cost of the new pavement.

Paving Construction in 1927—This work, paid out of the bond-issue funds, consisted only of removing the remaining granite-block paving on the south side of the street, grading the widened area, setting new curb and constructing a 6-ft. sidewalk. The grading was carried down only to pavement grade, so that water might not be ponded in the subgrade during the winter. With the curb and sidewalk laid, owners could improve and occupy their property, so that much of the discontent with the condition of this project was relieved.

Construction Work in 1928—When starting unhampered in the spring of 1928, the contractor was able for the first time really to organize the job. As only a 12-in. shaping operation was required on the south side, concreting was quickly under way. Concrete for the base was furnished by the General Material Company from its commercial central mixing plant. The length of haul to the western end of the job was 2 miles, and to the eastern end 3.7 miles, an average of 2.8 miles. The loads were approximately 2.25 cu.yd. of nominal 1:3:6 concrete, mixed in accordance with the city's specifications. Batches of sand and gravel were weighed separately, and the water was measured by a pressure-regulating tank equipped to discharge automatically any given quantity of water in accordance with a dial setting. Deliveries were made in rear-end dumping trucks.

It was soon apparent that night work would proceed faster and with less interference to traffic. This required the concrete company to organize a separate crew. It was found advantageous to begin the concreting at 5:30 p.m., as the peak of the evening traffic had passed, and there remained about two hours for daylight work before artificial light was needed. Approximately 13,200 cu.yd. of concrete was delivered during 41 working days, an average of 329 cu.yd. per day and 40.5 cu.yd. per hour.

Night operation ranged from 8 to 11½ hours, due to interruptions from rain and to catching up with the fine grading. If it had not been necessary to stop concreting early on a number of nights, through no fault of the concrete company, the average yardage per day would have been considerably higher. While at first the contractor's crew was pressed to place 250 cu.yd. in eight hours, this same crew placed 350 cu.yd. or more per night after getting used to spotting the loads properly and spreading with a minimum of effort.

Tests made at intervals showed a uniformly high strength in the concrete delivered. One series of cylinders made at the mixer gave an average 28-day strength of 2,558 lb. per sq.in.; cylinders from the same load when dumped at the job showed an average of 3,003 lb., an increase of 445 lb., or 17.4 per cent, after a haul of 2.7 miles. Interruption of cross-traffic was minimized by using an early-strength cement of local manufacture in the concrete placed on intersections, traffic being allowed to run over this concrete on the second morning. The excess cost of this cement was relatively small and its generous use was a large factor in completing the project quickly. Difference of depth between the granite block in the 8-ft. gutters and the sheet asphalt in the main roadway made it necessary to set forms at the gutter line to retain the roadway concrete. Wooden forms were used, heavily staked to the subgrade, and were removed as soon as the concrete had set.

It was originally proposed that the granite block paving for the gutters should be completed in advance of laying the sheet asphalt. This plan was abandoned on the ground that slight roughness in the surface of the granite would be repeated through the action of the rollers in the adjacent asphalt, and also for fear that in hot weather the freshly poured asphalt mastic filler on the granite blocks would adhere to the rollers and interfere with proper surfacing.

It was decided, therefore, to lay the asphalt as fast as the concrete was ready. For this purpose a temporary 4x6-in. wooden header was fitted against the shoulder in the foundation concrete and braced against the curbing. This device permitted the asphalt work to proceed without regard to the gutter work, which was usually one or two blocks behind the asphalt gang.

Recut blocks from the original paving were used for the gutters, the blocks being dressed to an approximate depth of 5 in. and with the same specifications for heel as for new granite. They were laid on a cushion of limestone screenings, which packed hard and made a more stable bed than the rather rough-grained sand available. The mastic filler was a 1:1 mixture of fine sand with asphalt cement of 60 penetration. As is customary in St. Louis, the two materials were placed in an ordinary grout buggy equipped with paddles, the mixing being done while wheeling the material from the kettles to the point where it was placed. The gutters were covered with torpedo gravel and rolled while the filler was hot.

For the sheet asphalt, the mixture is of the relatively coarse type used in St. Louis for several years, a typical grading being as follows: 32 per cent retained on 40 mesh, 25 per cent on 80 mesh, 16 per cent on 200 mesh, 17 per cent dust, 9.8 per cent bitumen. Aggregate consisted almost entirely of chat tailings from lead mills, which have been found more satisfactory than local sands. Where the grading was too coarse, it was corrected with a small amount of Mississippi fine sand. The asphalt maintained a satisfactory uniformity, ranging from 37 to 40 penetrations and ductilities from 75 to 110. Three rollers were in use, a 10-ton three-wheeler, a 10-ton tandem and a lighter roller for finishing. The progress per day worked averaged about 1,700 sq.yd. of binder and top complete.

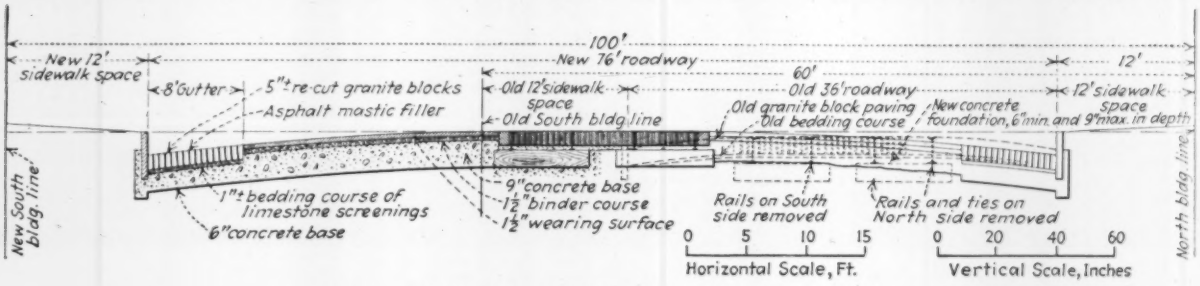


FIG. 4—ORIGINAL AND WIDENED PAVING OF OLIVE ST.

Recent figures compiled by Mr. Hoffmann, traffic engineer, show the following average numbers of vehicles per hour between 6 a.m. and 7 p.m.; 145 on the 36-ft. pavement in 1926; 460 on the incomplete pavement in 1926 and 1,170 on the new 76-ft. roadway in 1928. The contractor was the Bridges Asphalt Paving Company. The work was carried out under the general direction of the writer as chief engineer of sewers and paving, Board of Public Service, city of St. Louis, with Alden Chase as construction engineer and F. A. Winter as district engineer.

Specifications for Winter Concreting

A specification for making, placing and curing concrete in cold weather is being distributed throughout the United States by the Portland Cement Association, Chicago. The specification covers such items as equipment, temperature of the concrete, temperature records, housing, methods of heating, heating materials, antifreeze compounds, accelerators and preparation and removal of forms. It is the hope of the Portland Cement Association that the subject matter embodied in this specification will become a part of every general specification covering concrete that is placed under freezing conditions.

San Gabriel Flood-Control Dam in Immediate Prospect

Bids Opened Nov. 14 on Dam Requiring 3,800,000 Cu.Yd. of Concrete—Six Years Necessary for Completion

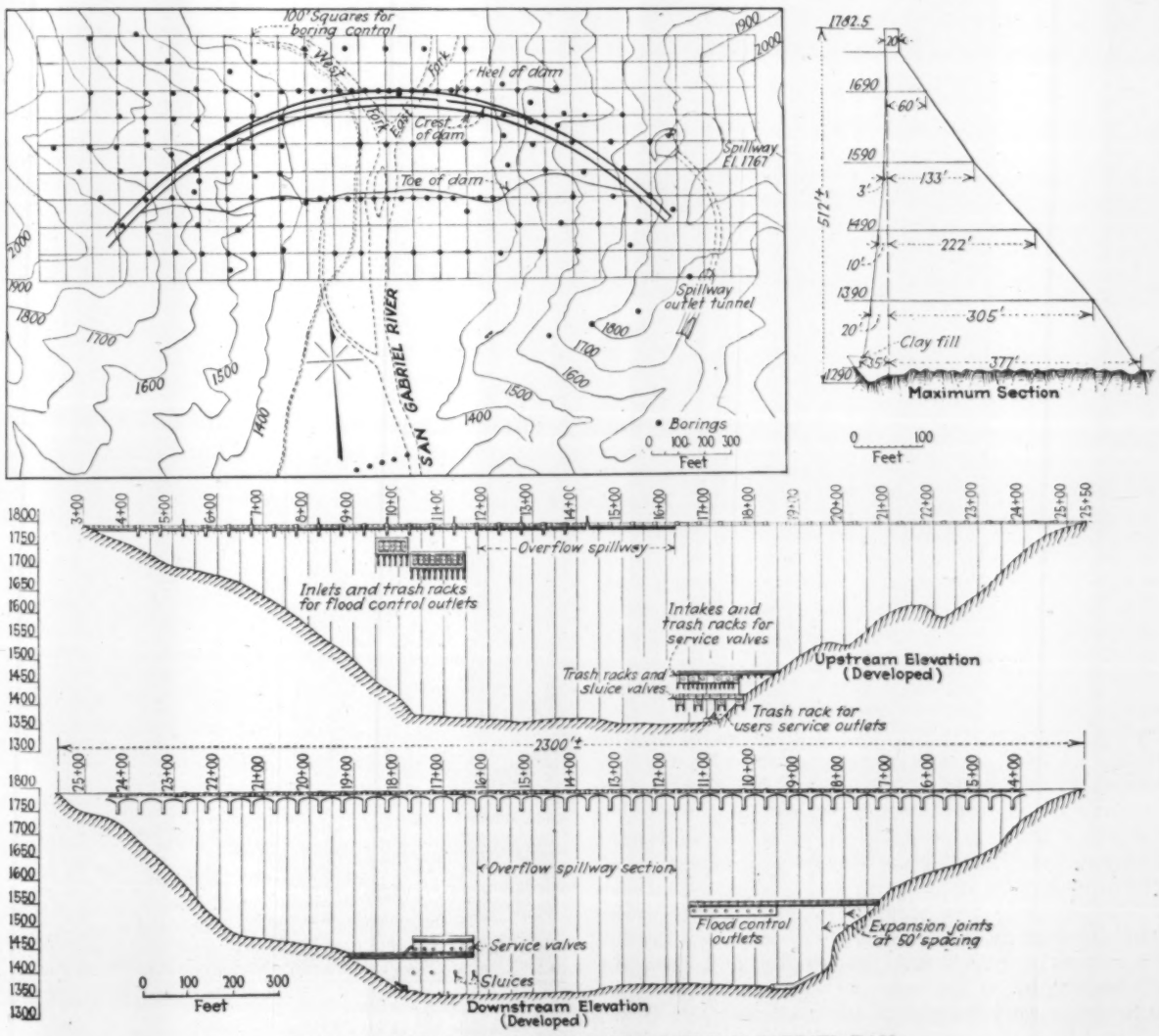
CONSTRUCTION of the San Gabriel dam in California may be expected to begin within the next few weeks, according to officials of the Los Angeles County Flood-Control District, by whom bids for the great structure were opened on Nov. 14. The function of this dam, a plan, section and elevation of which are shown in the accompanying illustration, will be twofold, its operation being planned to serve both conservation and flood-control purposes. Bonds for its construction were voted in May, 1924, but legal procedure caused a delay of more than three years. These difficulties have now been adjusted; an agreement signed by the several parties involved in the litigation was announced in *Engineering News-Record*, Aug. 9, 1928, p. 223. The call for bids was noted in the issue of Sept. 13, 1928, p. 414.

The dam site is about 30 miles east of Los Angeles at the junction of the east and west forks of the San Gabriel River. The structure will be of the arched gravity type, 425 ft. above streambed and about 500 ft. above the deepest rock excavations and will develop a storage capacity of 240,000 acre-ft. The concrete required will be about 3,800,000 cu.yd., or almost three times the yardage in the dam at Muscle Shoals. About 1,200,000 cu.yd. of excavation must be made to uncover the foundation rock, and this work is estimated to require about one year. Completion in six years is called for.

The site has been explored by about 150 core drill holes whose length aggregates 14,000 lin.ft., and numerous tunnels have been driven to check the borings.

While the primary incentive for the dam was the control of floods which from time to time have seriously damaged the San Gabriel Valley, the reservoir also is to be used for conservation purposes because of the high value of irrigation water in the district below this dam.

In the operation of the reservoir to satisfy the conflicting requirements of flood control and water conservation, it is proposed to reserve the lower 157,000 acre-ft. for conservation storage, leaving the remaining 83,000 acre-ft. for flood-control purposes. This arbitrary allotment of capacity rather than the provision of valves on the flood-control outlet is believed to be the more effective means of making sure that the flood-con-

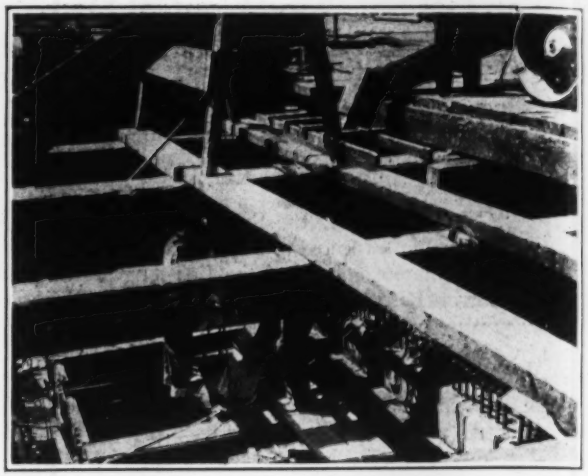


PLAN, SECTION AND ELEVATIONS OF THE SAN GABRIEL DAM

trol feature will not be interfered with by the desire for conservation.

For 34 years official stream-flow measurements have been maintained in San Gabriel Canyon, 8 miles below the dam site, where the drainage area is 222 square miles, as compared with the 204 square miles that would drain into the proposed reservoir. From records at this station the average annual runoff for the period of record is found to be 121,000 acre-ft. and the mean runoff 154,000 acre-ft. The minimum annual discharge occurred in 1898-99 and was 9,630 acre-ft., as against the maximum discharge of 410,000 acre-ft. in 1921-22. The maximum flood peak occurred Jan. 18, 1916, at 40,000 sec.-ft., the total discharge for that day being 44,600 acre-ft.

The engineering phases of the Los Angeles County Flood-Control District are directed by a board of consulting engineers consisting of D. C. Henny, of Portland, Ore., and J. B. Lippincott and J. W. Reagan, both of Los Angeles. E. C. Eaton is chief engineer.



POURING THE TREMIE CONCRETE FLOOR
Note side walls of concrete sheet piling with tops cut away to expose steel.

Subaqueous Conduit Built Without Unwatering Site

Concrete Sheet Piling Sides of 400-Sec.-Ft. Intake Carried Above Water Level So Cover Could Be Built in the Dry

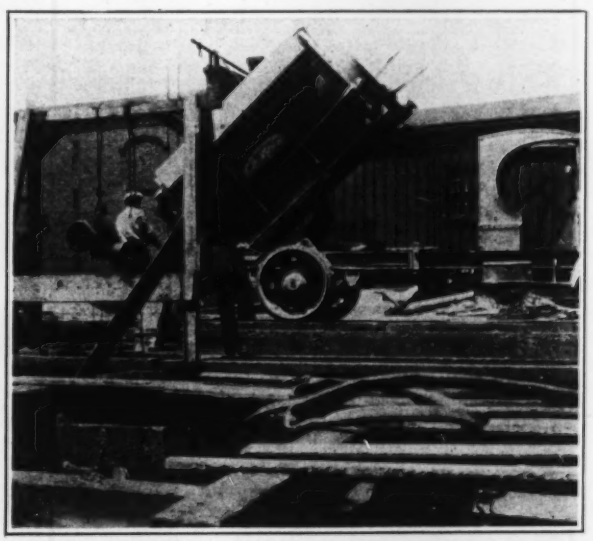
IN PLANNING a new cooling-water intake for a steam-electric station in San Francisco, a reinforced-concrete structure was designed which could be built without unwatering the site. Unwatering would have been expensive because of the heavy mud pressures involved. A novel combination of construction methods was employed: The side walls of the conduit, which is rectangular in section, were formed by two rows of concrete sheet piling between which a layer of tremie concrete was poured to form the bottom or floor. For the express purpose of allowing the top of the structure to be built in the dry, the piles were made long enough to extend above water level. Transverse reinforcing bars in the top were electrically welded to bars in the piles instead of overlapping for bond in the usual manner.

The station is a stand-by plant of the Pacific Gas & Electric Company situated on the shore of San Francisco Bay, from which the cooling water was previously taken through two 60-in. wood stave pipes laid seventeen years ago. These pipes were becoming unsafe due to decay and plans for a larger substation made it desirable to install an intake of larger capacity. Because of limited right-of-way, the new intake had to be built on the same strip of land previously occupied by the wood stave pipe. Before construction on the new intake commenced a temporary pumping plant was put in to serve as a bypass around the old intake, thus avoiding interference with operation of the steam plant during reconstruction. The temporary pumping plant, set up on a pile foundation, included two 66,000-g.p.m. centrifugal pumps, each driven by a 1,250-hp. motor.

The total length of the new intake is 438 ft., about half of which is in firm ground, where it was feasible to unwater a trench and pour concrete in open cut. About 210 ft. on the outer end had to be classed as subaqueous work because of the depth and soft quality of the surrounding mud. Several types of construction were considered for this subaqueous portion of the line, such as sinking precast sections or putting down a long pneumatic caisson, as was done in building a similar intake at San Diego (*Engineering News-Record*, March 1, 1928, p. 364). Time of construction was a factor, because the 90 ft. at the outer end had to be built under a wharf in a 60-day period during which the wharf could be taken out of service.

The method of construction adopted, as already outlined, gave a conduit cross-section larger than necessary, because the walls were made 9 ft. higher than would have provided the required capacity. The additional cost of this greater height, however, was less than the saving effected by working on the cover above water level.

The first step in the construction was the excavation of a trench through the mud and the chiseling of a trench approximately 2 ft. deep on the rock bottom along the two lines on which piles were to be driven. Auger borings were made as a test of foundation materials, thus affording a basis for estimating the required length of each pile. It was decided that a penetration



TRUCK DISCHARGING CONCRETE FOR TREMIED FLOOR
The small air hoist afforded convenient means of quickly changing tremie height during delivery of concrete.

WELDING STEEL BARS TO BOND TOP AND SIDES
View before cover was poured. Top of one side wall with projecting steel appears in foreground.

of 2 ft. into the serpentine would give the piles sufficient side bearing to take care of any probable loading, thrust or surcharge. The piles were cast 2 ft. longer than the length estimated as necessary, thus allowing a margin to compensate for irregularities in the bottom.

The point of each pile was given a "snipe" or bevel on one side so the lower end would be crowded against the adjoining pile by the process of driving. During driving a tie-back was used to pull each pile top into position against the pile last placed. Despite the fact that steel projecting from the top of the piles would be needed for bonding with the cover, all piles were cast with the full length of steel embedded in concrete. After the piles had been driven to grade, the concrete at the top was cut away to expose so much of the steel as was desired for bonding with rods that reinforced the cover.

With the side walls in place, reinforcing steel for the floor of the conduit was placed by divers. Transverse bars with a right-angle bend near each end were first rested on loops of reinforcing steel left projecting horizontally from alternate piles on both sides of the conduit. On these transverse bars the divers then placed the longitudinal reinforcing and the floor was poured by tremie, the concrete being allowed to flow around the steel bars. Bond between tremie concrete and side walls was made by means of transverse slots or recesses, 1 in. deep and 2 in. wide, cast on the inner side of each pile at floor level. To allow for variations in the bottom, these recesses were continued over a length of 4 or 5 ft. on each pile, thus making sure that some would be within the zone occupied by the 3-ft. concrete floor. The pile lengths ranged from 28 to 38 ft., but all were made 18x19½ in. in section.

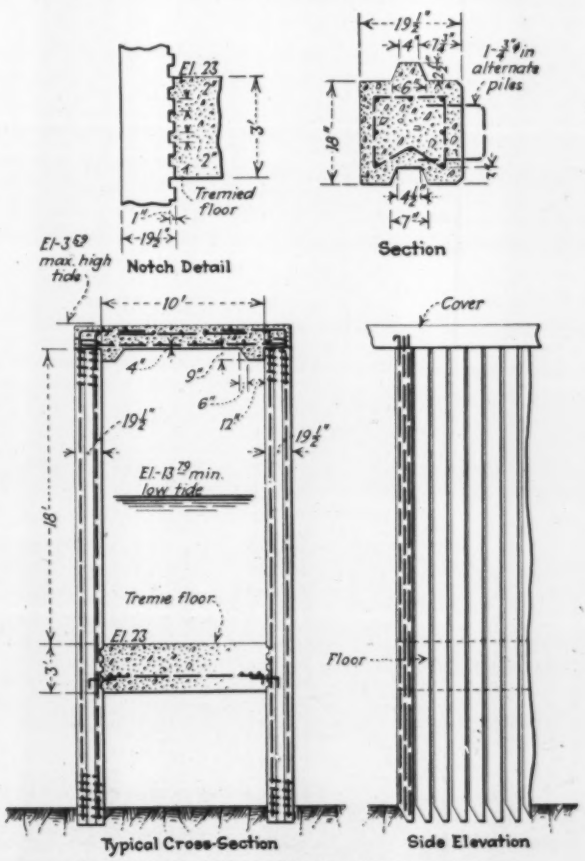
In preparing for the top or cover above water level that would transfer thrust across the structure, concrete was cut away from the pile tops down to a predetermined grade (in a very few cases the piles later had to be built up again a few inches) and then each rod for the upper layer of reinforcing in the cover was electrically welded to bars projecting from piles on opposite sides of the intake. Welding was adopted in place of the ordinary overlap method because of (1) the difficulty that would have attended driving the piles with 40-in. lengths of reinforcing protruding from the upper ends or (2) the additional cost that would have been involved in driving piles of sufficiently greater length to permit of later cutting away the concrete to secure the necessary projection of steel.

Laboratory tests showed that a 4-in. overlap was sufficient to develop almost the full strength of the bars, and to allow a margin on this a 6-in. overlap was used on the job. Results of laboratory tests on the welds are given in the accompanying table. The entire cost of making the welds, of which there were 850, was only about $700, which is believed to be much less than the extra cost that would have attended the casting and handling of piles with the extra 40 in. length of steel necessary for a 40-diameter overlap. The cover was reinforced to resist the thrust due to full-depth hydrostatic side loading of 110 lb. per cubic foot, this increase over ordinary water load being an allowance for mud.

All engineering and construction was done by the Pacific Gas & Electric Company's own organization

TENSILE STRENGTH TESTS OF ELECTRIC WELDS IN CORRUGATED REINFORCING BARS, 1 IN. SQUARE

Type of Joint	Length of Overlap	Number of Specimens Tested	Average of Ultimate Strength, Lb. Per Sq. In.
Without weld (for comparison)	..	3	59,559
Lap weld	6	3	53,190
Lap weld	5	3	52,023
Lap weld	4	3	52,887
Lap weld	3	3	46,997
Lap weld	2	3	42,507
Butt weld (double scarf)	..	3	53,147
Butt weld (single scarf)	..	3	39,267
Butt weld	..	6	33,020



SECTION AND ELEVATION OF INTAKE WITH PILING DETAILS

Complex Concrete Building Designed for Quick Construction

Equal Column Spacing, Method of Pouring Columns, Joist and Tile Floor Construction, Uniform Beam Sections and Few Changes in Column Sizes Cut Down Construction Time

By Dennis Hebold
Consulting Structural Engineer, Philadelphia, Pa.

ELEVEN floors of a twelve-story concrete building were poured in 44 days in building the Cambridge apartments at Germantown, Pa., a suburb of Philadelphia. Each floor had an area of 20,000 sq.ft. The general building plan, the column and partition arrangement and the floor and roof-slab construction are indicated by Fig. 1. Fig. 2 shows the appearance of the building, with the framework, floors, roof and a part of the outside walls completed fourteen weeks after excavation was started. Altogether in this time 6,400 cu.yd. of concrete, 540 tons of reinforcing steel and 140,000 pieces of 12x12x4-in. filler tile had been placed besides the exterior wall brickwork, as shown by Fig. 2.

The object of this article is to show (1) how soon after preliminary sketches are prepared actual building can be begun where reinforced concrete is employed, (2) the speed with which a reinforced-concrete framework can be constructed and (3) the modern design and construction devices employed in the Cambridge apartments which aided in attaining this speed with economy. Let it be noted that the area of each main floor was 20,000 sq.ft. The total floor area was 264,000 sq.ft. Also let it be noted that by the floor construction adopted (Fig. 1) the ceilings are ready for plastering. In a word, when the forms were poured a complete concrete building framework was produced.

Standardizing Design—The engineering design was begun March 12. As the owner could make an advantageous contract for reinforcing steel if complete steel lists, except for the roof and pent house, could be delivered on April 9, the engineers were given less than four weeks to design, prepare plans for and list the steel up to and including the twelfth floor. Then they were given until April 28 to complete the remainder of the steel plans and lists. By standardizing each and every part of the concrete structure this work was accomplished. Work on excavation was begun on April 9, and on July 15 the building was in the state of completion shown by Fig. 2. The method of standardizing the engineering design was for different structural elements as follows:

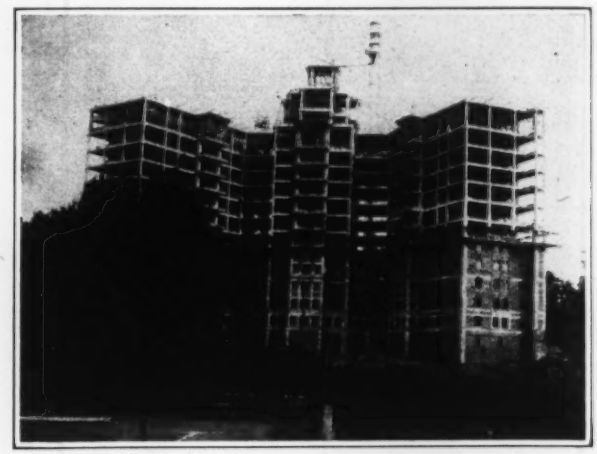


FIG. 2—THE CAMBRIDGE APARTMENTS FOURTEEN WEEKS AFTER BEGINNING EXCAVATION

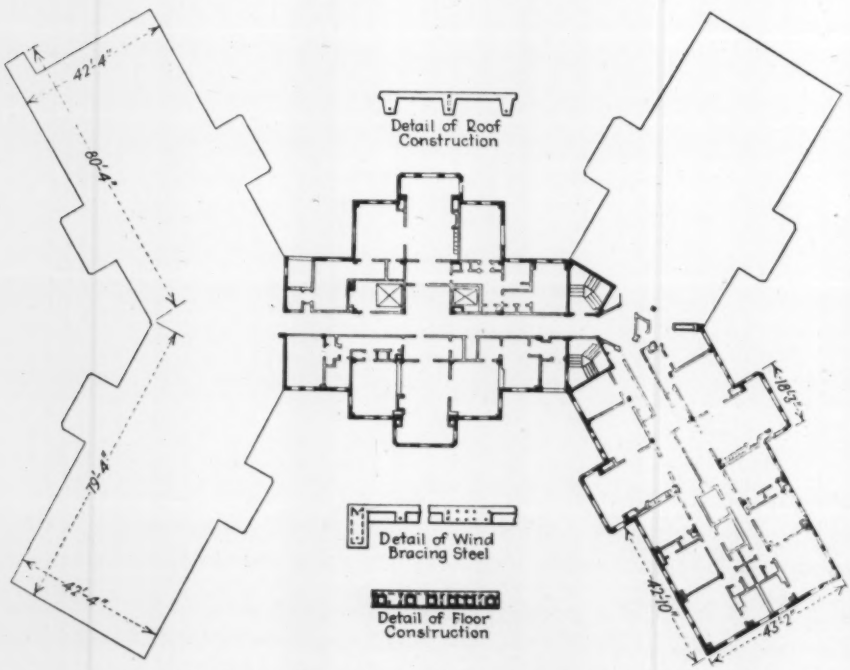


FIG. 1—DIAGRAM PLAN OF THE CAMBRIDGE APARTMENTS, GERMANTOWN, PA.

Floors and Roof—All interior and spandrel beams were made 8 in. wide and 18 in. deep. A clay tile and concrete joist construction (Fig. 1) was adopted for the floor slabs. This floor design simplified form construction by requiring only two widths of beam form panels, only one length of shores and only joist-bottom strips for floor slab forms. With a 2½-in. concrete cover and 4-in. filler tiles the depth of floor slab was 6½ in. Each

joist was reinforced with one bar, and these bars were alternately straight and bent.

In designing the roof the advisability of using the forms previously used for the floors was kept in mind. The filler tile were not wanted in the roof slab. Instead 6 in. deep removable form pans on hand from previous operations were employed and the roof slab was designed with a 2½-in. slab on 6-in. joists 24 in. apart as shown by Fig. 1. The joist reinforcement was made the same as for the floors. As the roof slab was 8½ in. deep as compared with the 6½-in. floor slab depth, the roof beams were made 20 in. deep so that the 18-in. side panels for the floor beam forms could be used for the roof beams.

Wind stresses were provided for in the floor system design (1) by additional reinforcing in the spandrel and interior beams parallel to the short side of each wing and

TABLE SHOWING COLUMN SIZE CHANGES AT FLOOR LEVELS

Type.....	*a*	*b*	*c*	*d*	*e*	*f*
No. of cols...	37	43	9	8	12	15
12th story 11th story	14 in. sq.	12 in. sq.	26x12 in.	26x16 in.	26x14 in.	14 in. sq.
10th story 9th story		16 in. sq.	26x16 in.			18 in. sq.
8th story 7th story	18 in. sq.	20 in. sq.	26x22 in.	26x22 in.	26x16 in.	22 in. sq.
6th story 5th story 4th story	22 in. sq.	22 in. sq.	26 in. sq.	26 in. sq.	26x22 in.	24 in. sq.
3rd story 2nd story		26 in. sq.	26x32 in.		26 in. sq.	26 in. sq.
1st story Basement			26x38 in.			

This group, numbering 124 column stacks, is 85 per cent of total number of columns. Types *a*, *b*, and *c* are tied columns throughout. Remainder of columns are made up of columns supporting pent house and tower. If change in column size was required, they were only made at four designated floor levels, such as 4th, 7th, 9th or 11th. In many cases a change floor was skipped; see case *a*, where changes were made at two levels only.

(2) by reinforcing a section of the floor where one row of tiles was omitted and the space filled with concrete as shown by Fig. 1. To overcome pipe problems arising from the absence of floor fill or suspended ceiling, the following solution was used: Electrical pipes were buried in the 2½-in. concrete topping. Horizontal plumbing pipes were embedded in the slab by omitting the clay tile fillers at these points. Heating risers were made to serve individual tiers of radiators and horizontal supplies, and the returns were run along the insides of spandrel beams and the spandrels furred to cover pipes.

The finish for floors was $\frac{5}{16}$-in. thick cork tile cemented direct to the rough concrete slab after it had just previously been evened up in low places with a special bonding mixture of cement. No dead load was therefore required to be figured for floor finish. As a result of these construction features a saving worthy of note was that typical story heights were only 9 ft. 1 in. floor to floor, with a clear height of 8 ft. 6 in. from finished floor to plastered ceiling.

Columns—The loads were determined and the columns were then arranged in groups so as to decrease the number of types. Then a scheme was devised whereby all column changes would occur at definite floor levels so that except at these levels the forms would not have to be returned to the ground for revision. How well this plan worked out can be seen from the accompanying table.

In so far as possible the columns were designed as tied columns with from ½ to 1 per cent of vertical steel; spiral and larger percentages of steel were resorted to only at the lowest stories and then only for columns supporting pent houses and towers. Structural steel cores were used for the four columns in the first story occurring in the lobby, where for architectural reasons the columns were held to 18 in. square, and two of them carried their share of the tower. All columns in so far as practicable were made square with two adjacent sides occurring at the intersection of partitions or walls and plumb throughout the height of the building. Soil good for 4 tons was encountered under the entire building. The footings were grouped similar to the columns, 85 per cent of the footings being one of six types.

Construction Methods—As stated, excavation was begun on April 9. The first floor was concreted on May 3 and the twelfth floor on June 25. The roof was poured on July 3.

The most unusual construction practice was the method of pouring the columns. Sufficient column forms were provided for only 60 per cent of the columns in the lowest story. These were set up, plumbed and poured to 2 in. above the bottoms of beams. After the forms were stripped the columns looked like so many square concrete piers approximately 8 ft. high (Fig. 3). This view also shows a stage of the work where carpenters are placing formwork for beams and slabs, bracing it against the columns previously stripped. The value of this method is (1) the bracing that is obtained for the floor forms without resorting to the elaborate system of diagonal bracing usually employed when columns are not poured until after the wood decking for the floors is in place, (2) the ease with which columns are stripped and (3) the saving in form lumber. Fig. 4 shows the equipment on wheels used to pour the columns.

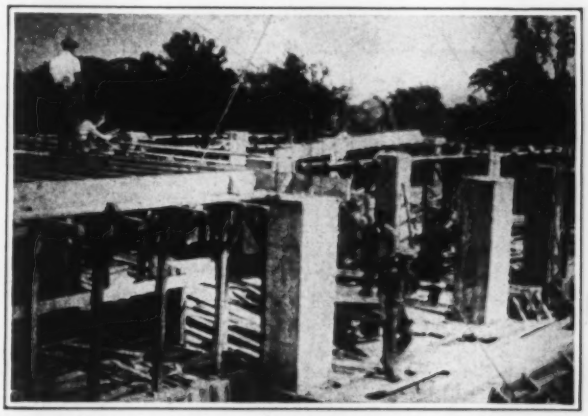


FIG. 3—COLUMNS CAST SEPARATELY AHEAD OF FLOOR SLABS

Four sets of floor forms were employed with the exception that for the faces of the spandrel beams and the beam sides at stairway and elevator shaft openings, where stripping was easy, only one set was employed. There was no reshoring. The floor forms were completely stripped in approximately fourteen days.

The plant consisted of a ¾-yd. mixer fed with sand and gravel from two bins of approximately 45 tons capacity each, constructed of heavy timber and planking. A runway was built leading to these bins so that deliveries by truck could be dumped directly into them. Cement was delivered in paper bags. The concrete was placed by means of chutes from a centrally located steel

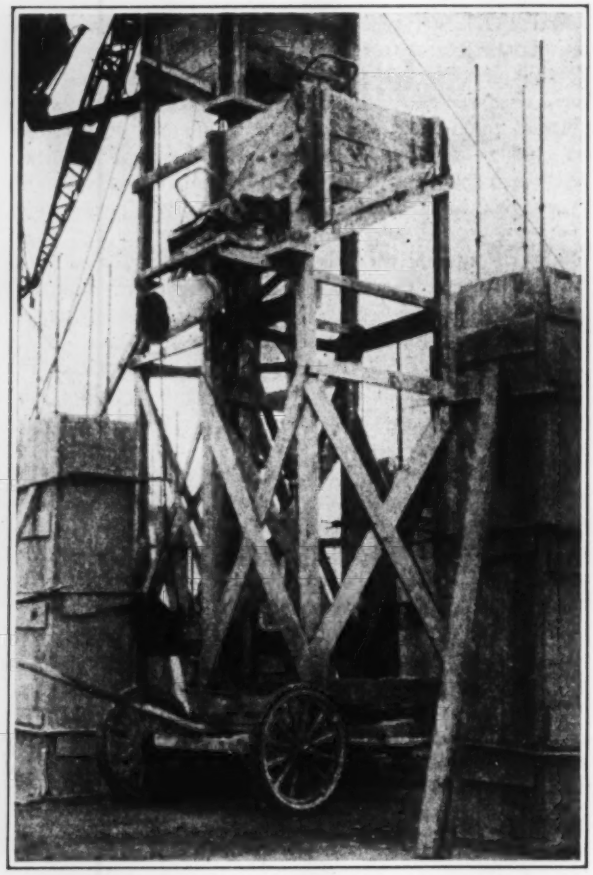


FIG. 4—TOWER AND CARRIAGE FOR CONCRETING COLUMNS

tower. Wooden towers for hoisting miscellaneous material were also constructed to each side of steel tower. To these towers booms were fastened by means of which the reinforcing steel was hoisted to the floors. All reinforcing steel was bent in the field. Abrams' water-cement ratio was adhered to in mixing the concrete, the tests showing approximately 10 per cent higher strength than was required by the design.

The building was constructed by the construction division of the Alden Park Manor Corporation, which is carrying out the development of which the Cambridge apartment is a part. The work was in direct charge of John Willison.

New and Simple Method for Determining Moisture Content in Aggregates

By Walter M. Dunagan

Instructor in Materials, Iowa State College, and Materials Inspector, City of Ames, Iowa

After using the methods in current use for determining moisture content in concrete aggregates—namely, the A.S.T.M. Standard C70-27T presented by Cloyd M. Chapman and the jar pycnometer method as used by the Iowa Highway Commission—the author believes the method described below to be quicker and to be less subject to error in workmanship. In addition it eliminates all breakage of apparatus. This method has been used by the author in research work in the materials laboratory at Iowa State College and as a field test during a paving project in Ames, Iowa.

The method here described makes use of the specific gravity principle and is subject to the same assumptions as are the other current methods. However, instead of the pycnometer or volumetric measure of displacement this method may be called the direct weight displacement method. The apparatus used in the field is shown in the accompanying sketch.

The equation used may be derived as follows: The terms "approximate apparent specific gravity" and "saturated and surface dry" are defined in Tentative Standard C68-27T, 1927, A.S.T.M.

Let S_1 = weight of sample saturated and surface dry.
d_1 = weight (or volume) of water S_1 will displace.
W_1 = weight of sample when immersed in water.
G_s = the approximate apparent specific gravity of the material.

Since $W_1 = S_1 - d_1$, and $d_1 = \frac{S_1}{G_s}$ then

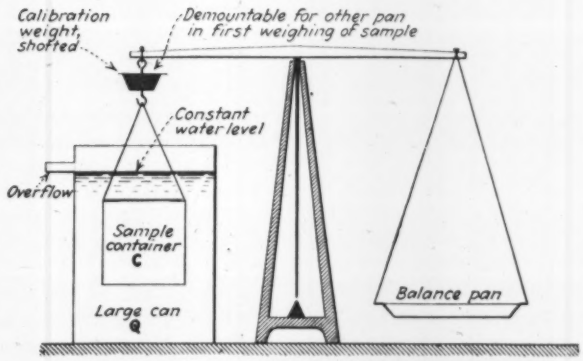
$$W_1 = \frac{S_1(G_s - 1)}{G_s} \quad \ldots\ldots\ldots (1)$$

Let S_2 = weight of sample containing x grams of free moisture.
d_2 = weight of water S_2 will displace.
W_2 = weight of sample S_2 when immersed in water.

If $W_2 = (S_2 - x) - d_2$, and $d_2 = \frac{S_2 - x}{G_s}$

then $W_2 = (S_2 - x) - \frac{(S_2 - x)}{G_s}$

and $W_2 = \frac{(S_2 - x)(G_s - 1)}{G_s} \quad \ldots\ldots\ldots (2)$



SPECIFIC GRAVITY APPARATUS TO DETERMINE MOISTURE CONTENT OF CONCRETE AGGREGATES

To solve for x subtract equation 2 from equation 1,

$$W_1 - W_2 = \frac{S_1(G_s - 1)}{G_s} - \frac{(S_2 - x)(G_s - 1)}{G_s} \text{ or}$$

$$x = \frac{G_s(W_1 - W_2) - (G_s - 1)(S_1 - S_2)}{G_s - 1}$$

Since S_1 is used equal to S_2 the equation becomes:

$$x = \frac{G_s}{G_s - 1}(W_1 - W_2) \quad \ldots\ldots\ldots (3)$$

After the preliminary determination of G_s and W_1 the equation for field use becomes:

$$x = K(c - W_2) \quad \ldots\ldots\ldots (4)$$

The procedure for using this method is as follows:

1. Calibrate the apparatus with the sample container, C, empty, and the large container Q full to overflow, this weight being zero.

2. Determine W_1 for the sample saturated and surface dry. From this weight compute the approximate apparent specific gravity and the equation is complete with the exception of W_2.

3. Determine W_2 and solve x. To find W_2 obtain sample to be tested and weigh to the nearest 0.5 gram. Fill container C about one-half full of water and pour in sample, stirring to eliminate air bubbles. Hang to balance arm immersing C in the large can, allowing the surplus water to overflow, and weigh. The result is W_2.

The equation $x = K(W_1 - W_2)$ gives the grams of free moisture in the sample; if positive the moisture is surface water, if negative it is water of absorption.

During recent use the size of sample has been sand 500 grams and rock 1,000 grams. The time for a test need not exceed five minutes.

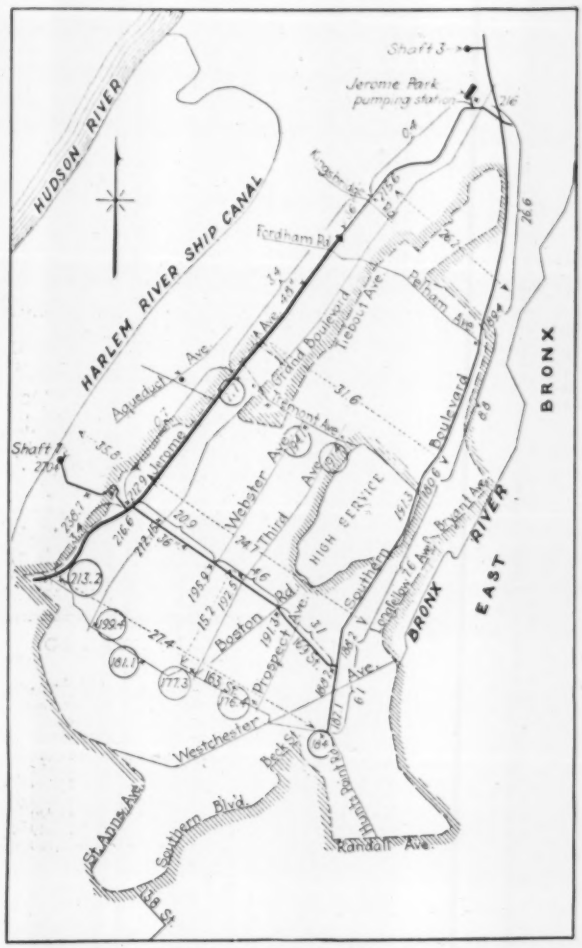
Water-Main Reinforcement Needs Shown by Surveys

New York City Determines Hydraulic Gradients to Locate Areas of Low Pressure or High Consumption

DETERMINING the hydraulic gradient of the water-distribution system as a means of locating low-pressure areas or relatively high-consumption areas has been practiced for a number of years by the Department of Water Supply of New York City. The rapidly developing and changing areas of the city require corresponding changes and enlargements in the distribution system. The distributing mains of a few years ago often prove inadequate for the present demands and rapidly developing areas. The pressures at several hundred points scattered over the entire system are determined, and these pressures, together with the corresponding elevations, accurately obtained by levels, are converted into heads in feet above a mean sea-level datum.

Manhattan borough has four service zones, each supplied under a head sufficient to maintain serviceable pressures at the ground elevation included. Roughly, the operating heads are: (1) Low service, 10 to 120 ft.; (2) intermediate, 125 to 200 ft.; (3) high, 250 to 280 ft.; (4) a small area of highest ground with pumped supply, about 325 ft. The supply to the city is from two major sources. The older or Croton supply reaches the city at a head of 133 ft. at Jerome Park reservoir in Bronx borough. The Catskill supply terminates in Hillview reservoir near the north city line at an elevation of 295 ft. above sea level. The low-service areas use the Croton supply under the full available head. The intermediate services are supplied with Catskill water under a reduced head and with Croton water pumped. The high-service areas are supplied by Catskill water under a full head. The small area of highest ground in Manhattan is supplied by direct pumpage from either Catskill or Croton with an elevated tank in Highbridge tower as an equalizer.

Whenever the increased water consumption in a district results in a material decrease in pressure, a gradient survey is made. The available head above sea level at different points is determined by means of pressure gages attached to fire hydrants of known elevation. An example of the results of such a survey is shown by the accompanying map of a portion of the intermediate service distribution system in Bronx borough, west of the Bronx River.



WATER-PRESSURE GRADIENT SURVEY IN BRONX BOROUGH, NEW YORK CITY

Intermediate service. Except where ringed, the pressures shown were taken between 10 and 12 a.m., May 17, 1927. The ringed figures (Tremont Ave. and 163rd St.) were taken June 2, 1927. All pressures should be compared with that in the 36-in. main, at the Jerome Park pumping station. The smaller figures, between witness lines, indicate drops in pressure.

This district is at present served from shafts 3 and 7 of the Catskill aqueduct. Instead of operating under a reduced Catskill pressure, the consumption demands in this district are such that at peak-load hours practically full Catskill pressure is required at shaft 7 to overcome extremely high losses of head. The 36-in. line carrying shaft 7 supply to the service shows a loss of head in a distance of 3,300 ft. of greater than 50 ft.

As a result of the study made of this district, plans are now under way for constructing a new 48-in. line as shown in the accompanying diagram.

These studies are being carried on under the direction of H. B. Nelson, hydraulic engineer for the Department of Water Supply, Gas and Electricity, under W. W. Brush, chief engineer.

British Death Rate Rose Slightly in 1927

The British death rate for the year 1927 was 12.3, or slightly more than for any year since 1922. An influenza outbreak in March is given as the cause for the increase. The birth rate fell to a new low level, 16.6, as compared with the previous minimum of 17.7 for 1918.

Iron Pipe 58 Years Old Is Reinstalled as Penstock

Sections From Inverted Siphon 30 In in Diameter Built in 1871 Passed Tests and Are Now Serving Modern Hydro Plant

By George A. Hunt
Engineering Assistant, Pacific Gas & Electric Company

WROUGHT-IRON PIPE installed for hydraulic mining service in California 58 years ago was recently dug up, and after being tested and reconditioned, was reinstalled and is now in service as a penstock supplying the Centerville hydro-electric plant of the Pacific Gas & Electric Company. The original installation as an inverted siphon was the first of its kind in the West and attracted the more attention because of the high head involved. The bottom of the siphon was more than 1,000 ft. below the intake, but due to the length of line and the friction head involved the maximum effective head on the lowest point was 887 ft. Descriptions of the original installations appear in the *Mining and Scientific Press*, Jan. 7, 1871, p. 1, and in "A Particular Treatise on Hydraulic Mining in California," published in 1885.

PLATE THICKNESSES AND MAXIMUM HEAD USED ON EACH THICKNESS

Thickness of Plates (Birmingham Gage)	Greatest Pressure: Head (Feet)	Greatest Pressure: Lb. Per Sq.In.	Max. Tensile Stress, in Lb. Per Sq.In.
14	170	74	13,374
12	288	125	17,202
11	293	127	15,875
10	355	154	17,240
7	435	188	15,080
3	594	257	15,420
1	842	365	17,549
00	887	384	15,360

The original installation was made by the Spring Valley Hydraulic Mining Company to convey water from Concow Creek on the north side of the Feather River to its mining properties on the south side of that stream. The sheets from which the pipe was fabricated were brought from Scotland, and were rolled by hand and riveted in the field into 23-ft. pipe sections, 30 in. in diameter. The plate thicknesses and the maximum head used on each thickness are given in the accompanying table.

The first installation, known as the Cherokee siphon, was 14,000 ft. long and for its entire length was buried in a trench 5 ft. deep. Three years later, in 1873, the mining company extended its operations and built a similar siphon across the same river near Magalia. This second pipe line was fabricated in the same manner and from the same material as the one previously built.

Both siphons were in continuous operation for fifteen to twenty years, but since the cessation of mining activities in the late eighties or early nineties the pipe lines have not been in use. Later, rights to properties of the mining company were acquired by the Pacific Gas & Electric Company and both siphons were dug up and dismembered. The pipe sections were found to be in good condition, and some of them, chiefly in the lighter thicknesses, were used in the various operations of the company for repairing flumes, for culverts under roads, etc.

When it became necessary to replace two 24-in. penstocks supplying the Centerville hydro-electric plant, it developed that if the heavier sections of the old siphons were in condition suitable for this service they could be reconstructed as a single 30-in. line that would replace the two 24-in. penstocks.

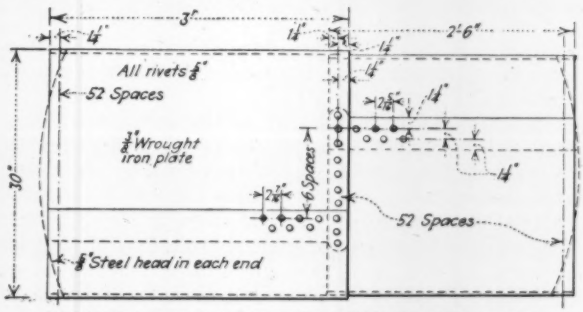
A hydrostatic test made in the company's laboratory on a section of $\frac{3}{8}$-in. pipe selected at random from the dismembered siphon showed highly satisfactory results. The section was arranged to subject one circumferential and two longitudinal joints to the test pressures, as shown in the accompanying drawing. The longitudinal seams overlapped $3\frac{3}{4}$ in. and were fastened by a double row of $\frac{5}{8}$-in. rivets staggered as shown.

Under a pressure of 300 lb. per sq.in. one of these longitudinal seams began to leak badly. After calking, the pressure was raised to 400 lb. per sq.in. and the seam then gave way to such an extent that further calking was impracticable. This seam was then welded, in order to determine the next point of weakness; this developed in the longitudinal joint of the other section, which began to leak at 525 lb. per sq.in. At this pressure no appreciable leakage had occurred in the circumferential joint.

The second longitudinal seam was then welded, and pressure was again applied and raised to 575 lb., when the circumferential seam began to leak at several points. After welding this seam the pressure was raised to 660 lb., when one of the $\frac{5}{8}$-in. "bumped heads," which had been welded into the pipe ends for the test, blew out, tearing the metal of the pipe about 2 in. back of the welded head for about half of the circumference of the pipe.

A test bar taken from the test section showed an elastic limit of 39,820 lb. and an ultimate tensile strength of 44,990 lb. per sq.in. Chemical analysis showed the following contents, rated in percentage: Carbon, 0.015; manganese, 0.006; phosphorus, 0.100; sulphur, 0.021; silicon, 0.056, and copper, 0.044.

After the hydrostatic test the old pipe was accepted as amply strong for the new service, where it would be under a maximum head of less than 570 ft. Accordingly,



SECTION ARRANGED FOR HYDROSTATIC TEST IN THE LABORATORY

1,253 ft. of the Cherokee pipe in the $\frac{1}{4}$- to $\frac{3}{8}$-in. thicknesses and 1,070 ft. of Magalia pipe, $\frac{1}{4}$ and $\frac{5}{16}$ in., were selected for the penstock service. In thoroughly cleaning the pipe inside and out by sandblasting, ample evidence was found that the original pipe had been thoroughly painted both inside and out with some sort of a black protective coating. Practically no pitting had occurred.

After the cleaning and some necessary re-riveting and refabrication to meet the requirements in the new line, the pipe was dipped in a hot petroleum product and kept there until both the pipe and the compound had a uniform temperature of 250 deg. After being drained, a $\frac{1}{16}$-in. thickness of the compound still adhered to the pipe, and while this was still hot sand was added to the outer coating as a protection against abrasion.

Engineering Literature

A Monthly Review of Books and a Listing of New Publications

Esthetics of Bridges

By Leon Moisseiff
Consulting Engineer, New York City

ÄSTHETIK IM BRÜCKENBAU Unter Besonderer Berüksichtigung der Eisenbrücken—Von Dr. Ing. Friedrich Hartmann, ord. Professor der Technischen Hochschule in Wien. Leipzig and Wien: Franz Deuticke. Paper or cloth; 7x10 in.; pp. 148; 117 illustrations, mostly halftones. Price in Germany, 15 marks in paper; 17.5 marks, bound.

Esthetics of bridges has come to be so live a topic that the publication of a work on the subject by an engineer of standing and culture is timely. The appearance of bridges has more recently gained in importance and interest because of two phenomena in our life, both of which have a common technico-economical cause. Due to the rapid rise in the wealth of our country, the development of automobile highway transportation has grown to a scale and intensity unheard of before our times. It is constantly and successfully demanding more and better roads and bridges, and as these structures make their appearance in the landscapes of the country and the towns the public becomes more and more interested in their esthetic fitness.

The task of creating bridges which should fulfill their function of safe and convenient structures, be economical in cost and maintenance and at the same time satisfy the sense of beauty of the average man of our time is not an easy one. The designer of bridges cannot always make use of stone and its substitute, concrete, to the continuous and solid texture of which man has been accustomed by ages. He is generally compelled by the demands of feasibility and economy to make use of the high resistance of steel. Commerce demands unhampered navigation, and bridges with fewer piers, high levels and longer spans must be built. Trusses of various geometric forms and types are the result. Esthetic tastes are the product of inheritance and habit, and change but slowly; steel members as the expression of lines of force may be bewildering. Only with time man becomes accustomed to understand them and to feel their elegance.

The author of this book is a well-known engineer and professor of Vienna. He fully realizes the difficulty of expressing the achievements of modern engineering in the esthetic habits of the past. He therefore believes that architects, as a rule, are distant from the conception of steel bridges. Structures which fitted in the landscapes of medieval towns do not meet modern requirements. Dogmas and slogans on the relation of the useful to the beautiful have lost their value. "Neither is the necessary always beautiful nor the beautiful always necessary. The reverse may be true in both cases." Engineers themselves should endeavor to develop the beauty of their structures. They should dispose the forces in the bridge to emphasize the essential, to interrupt rhythmically the monotonous and to indicate the minor importance of the auxiliary. They may thus avoid the cramped effect of computed members and the merely rational and attain the pleasure of good form.

With the aid of more than 80 photographs of bridges the author discusses the esthetic effect of existing structures. He displays good judgment and his criticism frequently hits the nail on the head. With a malicious pleasure he quotes diametrically opposed opinions of architects on the appearance of the Forth bridge. Most of the bridges discussed are European, but our outstanding bridges are included. The Brooklyn, Williamsburg, Manhattan and Hell Gate bridges in New York and the Delaware River bridge in Philadelphia receive attention.

The author appreciates the difficulties met in large bridges. Thus, in discussing lateral strength, he says that the esthetic feeling knows nothing of lateral forces. It realizes before all the great vertical load, but of lateral wind forces it has no conception. While not a rigorist in his ideas of beauty, the author insists that function should be clearly shown. He favors the utilization of the finer lines of steel bridges against massive masonry bridgeheads and flat steel plated portals. The Viennese atmosphere is reflected by the author's search for the graceful and elegant. Naturally he is against masonry towers and prays for their omission in the Hudson River bridge.

The book is well printed and the illustrations are well reproduced. The reader will find in it much interesting material and many stimulating thoughts.

A Worthy Centenary Memorial

JAMES WATT AND THE STEAM ENGINE: The Memorial Volume Prepared by the Committee of the Watt Centenary Commemoration at Birmingham, 1919—By H. W. Dickinson and Rhys Jenkins. Oxford: The Clarendon Press. New York: American Branch, Oxford University Press. Cloth; 8x11 in.; pp. 415; 104 illustrations. $21.

The James Watt Commemoration Week at Birmingham in 1919 was but a part of the object of the committee formed in honor of the centenary of the birth of the great inventor and engineer. The larger and more permanent work of the committee was the production of this volume, which is worthy of the man and of what he did for the steam engine.

The book deals first with James Watt the Man in less than a hundred pages. Fully three-fourths of the space is devoted to James Watt and the Steam Engine. The first part of the volume will satisfy the needs of the general reader. The remainder will be read largely by any and all who wish the full historical and technical details which it sets forth, and to these and many others will be valuable for reference.

In dealing with Watt the Man the authors, after summarizing his ancestry and early experiences, take up Glasgow Days, the Widening Circle (acquaintance with scientists of the day), Partnership With Boulton, Life in Retirement and Watt Portraiture. Born in 1736, the partnership was begun in 1774 and ended in 1800. The portion on Watt and the Steam Engine is concerned first with the experimental stage, 1765-74; then with the single-acting pumping engine, expansion, the double-acting engine, and the rotary engine and the application of the crank to the steam engine. There follow detailed reviews of the elements of the steam engine—valves and gears, cylinders, pistons, stuffing boxes, cranks, flywheels, lubrication, the counter, the indicator, etc. Boilers are then taken up. There are separate chapters on Applications of the Engine; How the Engines Were Made (at Soho); the Staff of Boulton and Watt; Rivals and

Pirates; Engines in Cornish Mines; Premiums or Royalties; Performance of Engines. A Bibliography covers sixteen pages and more than that space is filled with a reprint of "Directions for erecting and working the newly invented Steam-Engines," published in 1779. A brief summary of the Watt Centenary Commemoration and an index close the volume.

The volume promises to stand as the definitive work on its twofold subject Watt and the Steam Engine. Extensive drafts have been made on a mass of printed and manuscript material. Numerous rough sketches of the moment and working drawings have been reproduced. The best portraits of Watt, after noted painters, have been handsomely reproduced as plates. There are also portraits of ancestors, views of houses in which Watt lived and of the Soho manufactory.

Flow of Fluids in Industrial Plants

REVIEWED BY ROBERT E. HORTON
Consulting Hydraulic Engineer, Albany, N. Y.

A TREATISE ON CHEMICAL ENGINEERING Applied to the Flow of Industrial Gases, Steam, Water, and Liquid Chemicals, including the Pneumatic Transport of Powders and Granulated Materials. With Details for Calculating Fan Power, Pumping Power, Friction Losses in Pipes and the Like, Together with Full Practical Details of Measuring Flow and Viscosity of Gases and Liquids. A Practical Treatise for Engineers, Works Chemists, Chemical Engineers, Furnace Operators, Plant Designers, Works Contractors and Others—By Geoffrey Martin, D.Sc. (London and Bristol), Ph.D., F.I.C., F.C.S.; M.I.Chem.Eng., M.I.Struct. Eng. London: Crosby Lockwood & Son. Cloth; 7x10 in.; pp. given by chapters only; 188 illustrations, mostly line cuts. 63s.

Dr. Martin's book relates to the flow of fluids through pipes and orifices, with special reference to the conditions of flow existing in industrial plants. The flow of fluids in open channels is not treated. The use of the anemometer for measurement of the flow of air receives but brief mention and its cousin, the current meter, none at all. The Dewey decimal system of pagination is used, the chapter number preceding and the chapter page following the decimal point.

After introductory tables and data there is given an excellent discussion of the pitot tube measurement of the velocity of gases in pipes, with illustrations and descriptions of various types of pitot tube points and manometers. This is followed by a brief chapter on the distribution of velocity in pipes, relating directly to the velocity of gases. The rule for determining the mean velocity from a pitot tube traverse amounts simply to obtaining the mean ordinate of a transverse velocity curve plotted from observations taken along a diameter of the pipe and using this as the mean velocity. This, of course, is not the true mean velocity. For example, if velocity observations are taken at equal linear intervals along the diameter, the velocity at a point near the perimeter applies to a ring of greater area than one taken at a point near the center of the pipe. Since the velocity is less near the perimeter than near the center, the author's method gives an apparent mean velocity appreciably greater than the true mean. The true or ring method does not appear to be discussed or even mentioned anywhere in the book, although on p. 8.2 the mean velocity is correctly defined as the constant velocity at which the same volume of fluid would be delivered by the pipe as is delivered under the actual conditions of flow with the velocity varying from point to point across the diameter. It seems surprising that so palpable an error as that above described should occur. It may be explained by the fact that the discussion is largely confined to single point rather than traverse methods of velocity measurements in pipes.

The author gives a table (p. 8.6) for reducing the velocity measurement at the center of a pipe to the mean in cases of both laminar and turbulent flow, but does not give details as to sources of the coefficients.

On p. 6.3 it is stated that for parabolic transverse distribution of velocity in a pipe the velocity at 0.70 radius equals the mean for laminar flow. Elsewhere (p. 12.8) there is given an extended mathematical proof of Poisseuille's law (without naming it as such). This closely resembles but is no improvement on that given in Poynting and Thompson's Physics. In this demonstration a formula is developed from which there follows directly the result that for laminar flow the velocity at a radius $\frac{R}{\sqrt{2}} = 0.707\,R$ = mean velocity. It appears that here, as in some other parts of the book, the author has drawn largely from the work of others without providing the necessary connecting tissue to bring out the relationships involved.

The book centers around the idea of the application of kinematic viscosity to the determination of the flow of fluids of all kinds in pipes. At p. 12.1, v is used to describe the ratio of viscosity to density, and this is designated "kinematical viscosity." Later on in the book (p. 30.7) the same quantity is designated by γ and described as the kinematic viscosity. The expression

$$\frac{Velocity \times Density \times Diameter}{Viscosity} \text{ or } \frac{Velocity \times Diameter}{Kinematic\ viscosity}$$

apppears frequently in connection with the kinematic viscosity theory of fluid friction. The author gives this expression the specific appellation "modulus of viscosity," designated by M. This quantity is quite generally known as "Reynolds' number." Unfortunately M is also used to describe the related expression in which the maximum velocity is substituted for the true mean velocity in a pipe.

In selecting coefficients for reduction of central to mean velocity it is assumed that change from laminar to turbulent flow occurs when the modulus of viscosity is 2,500 in C.G.S. units. This is stated to be based on Reynolds' experiments, but no mention is made of the distinction between Reynolds' upper and lower critical velocities.

The nature of fluid friction in cases of both laminar and turbulent flow is discussed in a somewhat elementary manner. The mechanical model illustrating turbulent flow (p. 8.2) is certainly misleading, as it makes the motion of eddies appear to be axial, whereas in reality eddies are thrown off from or near the walls of a pipe and travel more or less transversely.

The general subject of turbulent flow is covered in five pages devoted mainly to Lee's formula, based on Stanton and Pannel's experiments. This is followed, however, by ten pages of examples illustrating the methods of computation based on this formula. The author naively remarks that although the results refer to smooth pipes only, the errors made on the assumption that the pipes are smooth will usually be less than the factor of safety allowed in excess diameter in design.

Considerable space is devoted to Bernouilli's theorem and its application both to incompressible fluids and to gases. Theory and practice in relation to venturi meters is also described at length, although some recent American experimental data are not mentioned. Then follows a discussion of head losses due to enlargements and contractions in pipes and due to pipe valves and fittings. This discussion, while based largely on standard

data relating to head losses for water, also includes head losses for the flow of air and gases and is a welcome addition to the dynamics of fluid motion.

In addition to the discussion of flow of fluids in accordance with the kinematic viscosity theory, an additional chapter appears containing various empirical formulas for flow of steam and other gases in pipes, with applications. Other chapters describe thermal methods of measuring the flow of gases, various types of steam, gas and water meters and the pneumatic transport of powders and granular material. Chapter 30 contains an interesting and fairly complete discussion of the fall of small particles through liquids, covering Stokes' law for various conditions, with Allen's general deduction of this law.

It is probably impossible to prevent errors of various kinds entering into the first printing of a book containing so much mathematical and numerical matter as this one. Aside from those already described, the errors noticed by the reviewer are of no practical consequence.

The book contains much material that relates directly or indirectly to hydraulic flow and will be found useful to civil as well as to mechanical and chemical engineers. Much space in the book is taken up by solution of actual examples, which will be particularly helpful in the frequent instances where the original experimental data on which the calculations are based are expressed in C.G.S. units. There are many excellent tables, particularly those relating to the determination of the flow of gases in pipes.

Each chapter is preceded by a list of authorities used in the preparation of the text and these are generally good ones. It is obvious that an enormous amount of labor has been expended in the preparation of this book and the author is to be generally commended for the judicious selection of the material included. The style is simple and lucid and the book will serve well as a practical manual for chemical engineers and others not specializing in the field which it covers, but it also covers the frontier of knowledge in relation to the laws of fluid friction and their application and so can be commended to specialists as well. The book is well printed and bound, well illustrated and contains a good index.

Fundamentals of Patent Law

PATENT LAW FOR THE INVENTOR AND EXECUTIVE—By H. A. Toulmin, Jr., of Toulmin & Toulmin, Patent Lawyers. New York: Harper & Brothers. Cloth; 6x9 in.; pp. 288; illustrated. $4.

Continuing volumes of patent litigation attest to the pitfalls that exist for him who invents, manufactures, sells, buys or specifies patented articles. This book is built on the belief that many of these pitfalls are of a man's own making and that fundamental knowledge of patent law, even equal to the ordinary understading of such commercial legalities as sales agreements, leases, etc., would save millions of dollars in litigation and contribute to the justice with which patent law should be administered. The author, a prominent patent attorney, relies most successfully on practical examples of patent cases to make clear the necessities of patent application, use and protection. The following chapter subjects, representative of those considered in the book, give some idea of what the book contains and to whom it is addressed: How to Get a Valid Patent; Choosing Between a Trade Secret and a Patent; Patent Purchase and License Agreements; Ownership of an Invention as Between Employer and Employee; How to Avoid Patent Infringement; Patents and the Income Tax; Evaluating Patents for Accounting Purposes; Patent Pools; Patenting Abroad; and Functions of the Patent Attorney. In the appendix are given a list of the valuations of patents, copyrights, etc., of a large number of companies, and a representative list of sections from the patent laws.

To Be or Not to Be an Engineer

THE ENGINEER, HIS WORK AND HIS EDUCATION—By Robert Lemuel Sackett, C.E., Dean of Engineering, Pennsylvania State College. Boston: Ginn & Co. Cloth; 6x9 in.; pp. 196; halftone portraits. $1.40.

Impressed with the fact that 15,000 young men enter yearly upon the study of engineering, many of them with little if any knowledge of what engineering is, Dean Sackett has written a book designed to inform, to warn and to inspire. The information tells of the work and of the essential qualifications of the engineer. The warning is to save those unfitted by nature and otherwise to become engineers from becoming misfits. The inspiration lies in glimpses of the romance of engineering and brief sketches of the lives of a number of eminent engineers.

After chapters on the selection of vocation, engineering as a life work and the history of engineering, the college course in engineering is outlined and a chapter is given each of a number of branches of engineering. Then follow the short biographies already mentioned.

The book is an admirable exposition of the theme indicated by the title. A wide reading of it by secondary school students and by those who may have an opportunity to advise such youths as to a choice of their life work would keep thousands of boys from ever going to an engineering college and would direct hundreds of others from some other profession or calling to that of engineering.

Pioneer Transportation Engineer

JOHN STEVENS: An American Record—By Archibald Douglas Trumbull. New York and London: The Century Co. Cloth; 6x9 in.; pp. 545; 50 illustrations. $5.

American engineering biography, still deplorably scanty after a century and a half of unparalleled engineering achievement participated in by hundreds of notable engineers, is enriched by this life of John Stevens, who might be termed the pioneer American transportation engineer. Born in 1749, graduated from King's College (now Columbia University) in 1768, admitted to the New York bar three years later, serving in the Continental Army and later as counsel for the East Jersey Proprietors, John Stevens became an inventor, a pioneer steam and railway engineer and a builder of both steamboats and railways. Of three able sons associated with him, one, Edwin A., was the founder of Stevens Institute of Technology, located on the large estate which John Stevens bought after the Revolutionary War, farmed, and on which he built steamboats and an experimental railway and, in the course of time, developed the beginnings of the city of Hoboken.

The author of the life of John Stevens is the first writer to have full access to the Stevens family records. These, supplemented by other authentic records, have enabled him to produce for the first time a detailed account of the part played by John Stevens in developing steam boilers and engines, steamboats, armored vessels, the steam locomotive and the American railway

system. Included in these activities was much pioneer work in establishing the American patent system, in obtaining state charters for steamboat and railway lines and, as an outcome of the long struggle between Stevens on the one hand and Fulton and Livingston on the other, in obtaining the notable decision by Chief Justice Marshall that a United States patent is not and cannot be limited by state legislation purporting to give exclusive rights—in this case, primarily for steam navigation on the Hudson River. Excerpts from the voluminous correspondence on this subject between Stevens and his rivals show what appears to be a combination of the results of his legal training and his natural common sense.

One of the most impressive parts of this interesting and stimulating volume is that which shows Colonel Stevens' early grasp of the advantages of railways. Had he been able to enlist support and carry out his earliest plans America would have led the world at the start, as it did soon and ever since has, in railway construction. Despite obstacles, he was a pioneer in railway promotion and construction and his sons carried on in a large way what he began. For years canal construction and its supporters rather than railway promoters held the American stage. Meanwhile he made progress with his twin methods, steamboats and railways, for the cheap and (relatively) rapid transportation of men and goods, which he clearly saw and forcefully declared was essential to the development of the vast areas of the United States.

An interesting topic given minor space is Colonel Stevens' service as one of the first directors and, in effect, engineer for the water-works built by the Manhattan Company and put in use in or about 1800. With characteristic foresight, he advocated a larger supply, to be brought to the city by a canal. This was only one of the visions of this far-seeing man. Among others, early in the nineteenth century, were bridges across the Hudson River and a tunnel *laid on the bed* of that stream.

Taken as a whole, the book is a notable contribution not only to American engineering biography but also to the early history of American engineering. To many its chief interest will lie in what will be material either to lessen or to increase the controversy over the early history of steamboat design and navigation, which naturally occupies a large part of the volume; but, as hinted in the foregoing sketch, the book contains much else that promises to be of interest and value to engineers, to publicists and—a fact not heretofore mentioned—to yachtsmen and horsemen, chiefly as regards Colonel Stevens' sons, whose various activities are given considerable space in this notable volume.

Reinforced-Concrete Building Design

HANDBOOK OF REINFORCED-CONCRETE Building Design in accordance with the 1928 Joint Standard Building Code—By Arthur R. Lord, C.E., President Lord & Halinger, Architectural Engineers, Chicago. Authorized Report from *Proceedings* of American Concrete Institute. Chicago: Portland Cement Association, Concrete Reinforcing Steel Institute, Rail Steel Bar Association. Flexible leather; 6x8 in.; pp. 261; line cuts.

Mr. Lord's exhaustive and painstaking compilation of rules, tables and diagrams for reinforced-concrete design is a remarkable contribution to the small list of indispensable handbooks in the engineer's library. This was quickly recognized upon its presentation as a paper before last February's meeting of the American Concrete Institute, but as the compilation then was available only in pamphlet form, its practical value was restricted. It now becomes available in a form that is adapted to daily use. The handbook covers separately beams, columns, footings, slabs, proportioning for combined stresses, and web reinforcement, and follows with an extensive section on quantities for estimates and cost comparisons of alternative systems of design. One of its leading advantages is the inclusion of tables and data for concretes of different strengths, from 2,000 to 3,750 lb. per sq.in., so that designs and estimates can be made for any desired grade of concrete. Some carefully worked out discussion directs attention to the economies that may be achieved through the use of the stronger concretes under suitable conditions.

Correspondence

A Critic Criticised

Sir—In *Engineering News-Record* of Sept. 20, 1928, there appears a criticism by Wellington Donaldson of Professor Buswell's "The Chemistry of Water and Sewage Treatment." Mr. Donaldson states:

"In the section on sewage all the so-called aerobic or oxidizing processes are dealt with under Removal of Colloids. This conception is not objectionable, but apparently has led the author into the error of assuming that having removed the colloids the job is finished. On the contrary, the bacterial quality of sewage effluents is frequently of more importance than physical and chemical qualities."

Mr. Donaldson is clearly in error in both parts of this paragraph. Practically all the quick biochemical oxygen demand of sewage is due to its colloidal fraction. Any process which will remove the colloidal fraction will at the same time remove the suspended matter fraction. The removal of both these fractions will result in an average improvement in the biochemical oxygen demand of 90 per cent in the ten-day demand and 97 per cent in the 24- and 48-hour demands. These figures were obtained as a result of a great many dialyses and ultra-filtrations of different sewages. The dialyzer used was described in *Industrial and Engineering Chemistry*, Vol. 29, p. 811.

Mr. Donaldson in the second part of his paragraph leaves the impression that, even though the colloids be removed, such effluents would still contain enough bacteria to impair their quality. As a matter of fact, the bacteria are colloids and the removal of the colloids will result in a complete removal of the bacteria.

O. M. URBAIN,
Of Urban & Hunt,
Industrial Research Chemists.

Columbus, Ohio,
Sept. 24, 1928.

* * *

Sir—The reviewer takes no exception to the contention in Mr. Urbain's communication of Sept. 24 that "Practically all of the quick biochemical oxygen demand of sewage is due to its colloidal fraction." Neither does he see the necessity, on that account, of revising the opinions expressed in connection with his review of Dr. Buswell's book in the Sept. 20 issue of *Engineering News-Record*. Mr. Urbain apparently has fallen into the same error as has Dr. Buswell and through the same line of reasoning—namely, in assuming that sewage purification necessarily ends with a clarified effluent. Strongly opposed to this view is the undeniable existence of several hundred sewage-works both in this country and abroad where disinfection is practiced on raw sewage, screened sewage, tank and filter effluents and even activated-sludge effluents. The large-scale chlorination at Cleveland, New York City, Providence and Pasadena are typical examples of an extensive practice. For these reasons the reviewer has felt it proper to call attention to the obvious omission, in a book intended to depict present-day practice, of any discussion of sewage disinfection or the hygienic aspects of sewage effluents, whereas water sterilization is ably treated to the extent of some eight pages.

To consider the bacteria as being part of the sewage colloids is useful for some purposes, but such a classification has uncomfortable limitations. Even by the simple criterion

of particle size, it should be recalled that many bacteria, particularly some of the "sulphur" group, exceed many fold the dimensions adopted by Dr. Buswell as the upper limit of the colloid particle—namely, one micron. Also, it is not straining a point to recognize a valid distinction between inert finely divided chemical substances on the one hand and minute living organisms on the other which may have the power of causing disease in human beings. The latter distinction is the basis for disinfection in some important instances of screened or partly treated sewage, where clarification is not attempted or justified, and in other instances of treated effluents entirely satisfactory as to appearance and organic content, as indicated by the biochemical oxygen demand figure.

W. DONALDSON.

New York City,
Oct. 13, 1928.

Publications Received

A PRELIMINARY REPORT on Protection Forests of the Mississippi River Watersheds and Their Part in Flood Prevention, by E. A. Sherman, associate forester, U. S. Forest Service, has been prepared as a 49-p. "circular" as the result of a Presidential order dated June 1, 1928, addressed to the Secretary of Agriculture, the order being based on Sec. 10 of the "Act for the Control of Floods on the Mississippi River," etc., approved May 15, 1928. The report states that only some 40 per cent of the Mississippi drainage basin was ever covered by forests and that this has been reduced half, or to about 244,000 square miles. The administration of a portion of these lands and of some additional areas, so as to retard torrential runoff and soil erosion, is recommended. It is stated "that forest rehabilitation is not urged as an alternative to engineering works for flood control."

A FURTHER EXAMPLE of what the author calls "a new style of writing water reports" is given by Sir Alexander Houston, director of water examination, Metropolitan Water Board, London, England, in his 22d annual report (21s. from P. S. King & Son, 2 Great Smith St., Westminster, England). This year's feature is another personally conducted trip through the gathering grounds of the London water supply, in the form of descriptive text and numerous handsomely reproduced photographs. The Thames and the wells in the Kent chalk having been described in earlier reports, the River Lee is taken up in the present one. Altogether some 35 pages are devoted to "The Lee as a Source of Water Supply," the descriptive matter and illustrations relating for the most part to the countryside and the many and various notable historical literary characters associated with. About as much space is devoted to a well-presented mass of analytical data, accompanied by descriptive and explanatory text, pertaining to chemical and bacteriological examination of London waters for the calendar year 1927.

THE NEW QUARTERLY entitled *Sewage-Works Journal*, under way for some months past, made its first appearance in October as an octavo publication of 109 pp., not including a dozen pages of advertising. It is published by the Federation of Sewage Works Associations, at 85 Beaver St., New York City, at $3 a year to non-members of the constituent state and local associations, and $1 to such members. The editor is F. W. Mohlman, chief chemist, Sanitary District of Chicago. C. A. Emerson, Jr., of Fuller & McClintock, Philadelphia, is chairman of the federation. The contents of the first number of the journal are classified under Federation Affairs, Sewage Research, Sewage-Works Operation, Industrial Wastes and Stream Pollution, Editorial, Proceedings of [twelve] Local Associations and Reviews and Abstracts.

New Books and Revised Editions

[Those desiring copies of the books listed below or mentioned elsewhere in this section should order them from the publishers or from their local booksellers.]

ELEMENTS OF HIGHWAY ENGINEERING—By Arthur H. Blanchard, M.Am.Soc.C.E., M. Soc. Automotive E., etc., Consulting Highway Engineer and Traffic Control Consultant, and Roger L. Morrison, M.Am.Soc.C.E., M. Assoc. Asphalt Paving Technologists, etc., Professor Highway Engineering and Highway Transport, University of Michigan. Second Edition, Rewritten and Reset. New York: John Wiley & Sons. London: Chapman & Hall. Cloth; 6x9 in.; pp. 350; 158 illustrations. $3.75 net.

GEWÖLBETABELLEN Vereinfachung für Entwur und Berechnung statisch bestimmter und unbestimmter Gewölbe—Von Dr.-Ing. F. Kögler. Zweite, erweiterte Auflage. Berlin: Julius Springer. Paper; 6x9 in.; pp. 104; tables and diagrams. 7.5 marks.

LABOR COSTS OF CONSTRUCTION: A Reference Book for Engineers, Architects, Contractors and Builders—By Frank L. Connor, Contractor. Chicago: Gillette Publishing Co. Flexible; 5x8 in.; pp. 202. $3.

THE PORTS OF SOUTHERN NEW ENGLAND—Prepared by the Board of Engineers for Rivers and Harbors, War Department, in Co-operation with the Bureau of Operations, U. S. Shipping Board. Paper; 6x9 in.; pp. 336; halftones and folding maps. 85c. from Superintendent of Documents, Washington, D. C.

QUEBEC STREAMS COMMISSION: Report for 1926-27. Paper; 7x10 in.; pp. 151; maps, graphs, and tables of gage readings.

THE RISE AND FALL of Disease in Illinois: Vol. II, Local Health Conditions and Public Health Work—By Isaac D. Rawlings, M.S., M.D. [Director Department of Public Health], in Collaboration with William A. Evans, M.D., D.P.H., Gottfried Koehler, M.D., and Baxter K. Richardson, A.B., Springfield, Ill.: State Department of Health. Cloth; 7x10 in.; pp. 493; graphs and half tones.

Historical and descriptive sketches of 28 municipalities, their health and allied activities, and the respective health officers. Chicago is given 87 pp., including space devoted to the Chicago Sanitary District.

Letters to the Editor

Regional Engineering

Sir—I have read with much interest your article on "Regional Engineering." You have worked out the major problems connected with this phase of community development in a concise and masterful manner. If it were possible to overcome the political issues involved in such comprehensive planning, the work would be made possible with less effort on the part of the engineers charged with responsibility for such projects.

We shall look forward with interest to further articles, for this is a much needed contribution to the engineering literature of the day.

F. A. CUSHING SMITH,
Town Planning Engineer.

Chicago and Wilmette, Ill.,
Oct. 10, 1928.

* * *

Sir—I was extremely interested in your first article on "Regional Engineering," as well as the editorials "Basic Highway Data" and "Coming Transformations." Our work here is fundamentally the preparation of a regional plan, which includes the preparation of city plans for three cities included in the region. The region covers 56 square miles and contains a population of 55,000. It has every problem the larger metropolitan areas of the country have, with the exception of skyscraper districts, although we have a 155-ft. building and several others more than 100 ft. high.

I can vouch for the truth in your statement (p. 495) to the effect that "the administrative or political phase of the regional problem is central to the whole case." Then on p. 497 you say that the "greatest obstacle is lack of governmental machinery." Illinois, however, by permitting the creation of all sorts of "districts," with independent taxing and bonding powers from the city, township, county and state governments, seems to favor regional planning pretty well.

Just now we are giving most of our attention and time to the study of our park situation and the possibility of organizing a park district, mainly in order to permit the obtaining of funds to operate properly the existing park facilities as well as to acquire additional property without the necessity of special bond-issue elections. Then we intend to give some study to the creation of a sanitary district and a metropolitan water district.

ROBERT T. JACOBSEN,
Resident Engineer,
Randolph-Perkins Company.

Moline, Ill.,
Oct. 8, 1928.

* * *

Sir—Keep up those Regional Engineering articles in *Engineering News-Record!* The first one, Oct. 4, is a tremendous help in clarifying for us the skeleton of the problem.

Particularly helpful is the analysis of the elements of regional planning. These are myriad, of course, but generally lie in the main divisions the article outlines and certain others which undoubtedly are to be described later in the series. In the Chicago Regional Planning Association the directors have sorted the activities into the subjects of airways, highways, railways, waterways, parks, sanitation and water supply, subdivision, platting and zoning, public utilities, public health, legislation and general survey. Into each

division have been assembled the officials in charge of that work for the several major governmental bodies, so that the general plan and each unit of it have both general and local problems solved by those in authority.

If in your study of the several regional planning organizations you find support for the engineering principle that we have set up as basic, we shall be pleased to see special mention of it in the articles. I refer to the principle we believe to be the fact in the region of Chicago—that the problems to be solved are directly in proportion to the quantity of population and that all of the elements you have set up must be analyzed and designed in proportion to expected population.

More information we all need, and it is our earnest wish that this will be a long series of articles and all as searching and accurately done as the first. ROBERT KINGERY,
Chicago, Ill., General Manager,
Oct. 23, 1928. Chicago Regional Planning Association.

* * *

Sir—I have read your interesting article in the *Engineering News-Record* of Oct. 4 on Regional Engineering and am greatly pleased that your journal purposes to describe several regional projects. I am convinced that the discussion of this subject in such technical papers as the *Engineering News-Record* is timely and will be profitable to the engineering profession.

For a number of years it has been realized by those who have been identified with city and suburban growth and development that the regional aspect of the subject must receive more active attention.

The metropolitan regions surrounding our cities have grown by leaps and bounds in recent years. Independent satellite towns and real estate developments have sprung up in every direction, all without central or regional governmental control or regulation, thus creating difficult planning conditions when the region is considered as a whole. Unless active measures are taken in the very near future the comfort and convenience of the people living in these sections will be seriously affected.

I trust your journal may assist in bringing about a regional consciousness so that our people may think in regional terms.

GEORGE S. WEBSTER,
Philadelphia, Pa., Consulting Engineer.
Nov. 2, 1928.

* * *

Sir—I have read with the greatest interest Mr. De Berard's article "Regional Planning, Its Problems, Status and Future Requirements" in the Oct. 4 issue of *Engineering News-Record*.

During the past ten or fifteen years we have been doing much city planning within the somewhat arbitrarily chosen boundaries of municipalities. In all of this work the engineer is playing a most important part.

Experience in the planning of cities has so enlarged our horizons that we are rapidly becoming conscious of the city not as an arbitrary political unit but as an area bounded by topographical conditions and numerous social and economic conditions inextricably interwoven. It is not exclusively an engineering problem but one in which many of the major factors involved are of an engineering nature. It is a challenge to the leadership of the engineering profession.

We know amazingly little of our urban conglomerations. I trust that from time to time *Engineering News-Record* will find opportunity to publish additional articles upon this general subject and for numerous metropolitan areas or regions. HARLAND BARTHOLOMEW,
St. Louis, Mo. City Plan and Landscape Engineer.
Nov. 8, 1928.

* * *

Sir—The discussion of engineering problems in metropolitan regions as given in *Engineering News-Record* of Oct. 4 and the later articles promised should prove of great interest and value to engineers. While regional planning is comparatively new, it has made great progress in recent years. Your article points out very clearly the importance of regional engineering in any project for the development of a modern metropolitan region.

A comprehensive plan for future growth should be the joint product of engineers, architects, landscape architects, economists, sociologists and business men. But the modern city is so mechanical in its structure that an engineering analysis of its many problems forms the most useful groundwork for such a plan. Likewise the design of facilities adequate for future needs must fall primarily upon members of the engineering profession.

Civil engineers should accept the responsibility which is before them and do their share toward solving the difficulties caused by metropolitan methods of living and doing business. It is important, however, that they approach the problem with a realization of the need for co-operation in planning as well as execution.

HAROLD M. LEWIS,
New York City, Executive Engineer,
Nov. 8, 1928. Regional Plan of New York and Its Environs.

* * *

Sir—I think this new departure on the part of the *Engineering News-Record* is an excellent one. I think I am well within the facts when I say that with a few notable exceptions, Nelson P. Lewis, for example, members of the American Society of Civil Engineers have not been either city-planning minded or regional-planning minded. An outstanding need is to bring about a greater interest on the part of engineers and the public generally in these subjects.

Among the many interesting details which you bring out the political problem is among the most difficult, and that is indeed a challenge to engineers. We have found it almost overwhelmingly important here. STEPHEN CHILD,
San Francisco, Calif., Consultant in City Planning.
Nov. 2, 1928.

Elements of Good Practice in High Dams

Sir—I note in your Oct. 25 issue "Elements of Good Practice in High Dams," with the views of D. C. Henny. Mr. Henny mentions under "foundation problems" the buttress type of dam with its sloping face.

I do not understand why engineers do not, as a rule, look more favorably upon this type of dam. As Mr. Henny says, the tax on the foundations can be made much less with this type of dam than with the gravity type. At the same time the maximum pressures in the concrete can be kept very low. The uplift bugaboo disappears, mathematics are very simple and construction no more difficult than in the gravity type. I have designed and constructed several dams consisting of buttresses and semicircular arches and without reinforcement of any kind. These dams have been entirely successful. In some cases the overflow has been allowed to fall directly upon solid rock foundations and in other cases a downstream face has been built corresponding in contour to that of the ordinary gravity section.

A good example of this type of dam is the Sherman Island dam on the Hudson River, which has been very fully described by H. de Berkeley Parsons in the *Transactions* of the American Society of Civil Engineers. It seems to me that there are so many cases where this type of dam would absolve vexatious problems that it should receive much more consideration than apparently is the case.

A. H. WHITE,
New York, N. Y. Vice-President and Chief Engineer,
Oct. 26, 1928. International Paper Company.

The Sherman Island dam is situated on the Hudson River above Glens Falls, N. Y. The two extremities of the dam are founded upon rock, but the greater portion of it is founded upon a bed of boulders and gravel of great depth filling the prehistoric gorge of the river at that point. A description of the dam was given in *Engineering News-Record*, Sept. 20, 1923, p. 470.—EDITOR.

A Manual of Dam Failures

Sir—Your editorial of Oct. 25 advocating the preparation of a code of dam-building practice will, I believe, have general approval of the engineering profession. Some months ago I suggested to the American Society of Civil Engineers that it consider the desirability of having prepared, under its sponsorship, a manual of dam failures which would include, besides a complete compilation of such failures, discussion of their causes and of the conclusion to be drawn from them. Such a manual would make a splendid preliminary and companion volume for the code which you now suggest. JOSEPH JACOBS,
Seattle, Wash., Consulting Engineer.
Nov. 4, 1928.

News of the Week

Malcolm Muir Chosen New President of McGraw-Hill Company

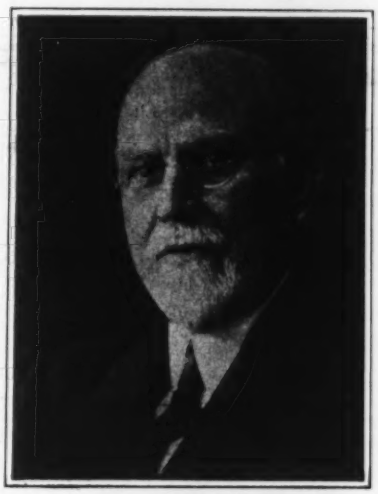
James H. McGraw Remains Chairman of Board—Muir 23 Years in Publishing Work

TO PROVIDE more effectively for the increased executive responsibilities due to recent expansion, the McGraw-Hill Publishing Company last week made important changes in its organization. James H. McGraw, founder of the company, resigned the presidency in order to be relieved of administrative detail. He was re-elected chairman of the board. Malcolm Muir, formerly vice-president, succeeds him as president and also becomes chairman of the executive committee. James H. McGraw, Jr., was elected vice-chairman of the executive committee and chairman of the publishing committee. The company, through nine associated and subsidiary companies, now publishes 24 magazines in the fields of engineering, industry, merchandising and business management in New York, Chicago, San Francisco and London, in addition to engineering and scientific books, catalogs and directories.

Mr. McGraw, who continues under the new executive arrangement his active leadership in the McGraw-Hill Publishing Company, has been the head and guiding spirit of the organization

Malcolm Muir

for 40 years, and developed the present company from one paper, *Street Railway Journal*, acquired by him in 1888. Mr. Muir has been with the organization of which he now is president for 23 years. His first work was with *Electrochemical Industry*, now *Chemical and Metallurgical Engineering*, on which he was in particularly close contact with the late Dr. E. F. Roeber, editor, as well as with the business management. Advancing progressively, in 1917 Mr. Muir became general manager of that paper, together with *Coal Age* and *Engineering and Mining Journal*. Soon afterward he entered the executive organization of the company and became vice-president, a position he held for ten years until his present promotion. He has been active also in wider publishing circles and was president of the Associated Business Papers two years ago.



James H. McGraw

Flood-Control Changes Predicted by Ransdell

That the flood waters of the Mississippi River can be satisfactorily controlled within the next ten years at an ultimate cost of $650,000,000 has been predicted by Senator Ransdell, of Louisiana, upon condition that Congress approaches the problem in the same spirit and policy which it adopted with respect to the Panama Canal. Recognizing the fact that flood control is the greatest problem the nation has ever been called upon to solve, Senator Ransdell believes that certain amendments must be made with respect to several features of the flood-control act before the work can progress satisfactorily. He refers particularly to the proposed spillways opposite Cairo and at the end of the Boeuf and Atchafalaya basins. His cost estimate is intended to include not only the Mississippi but also the lower portions of the great tributaries and, though admittedly approximate, may, he claims, be lowered by future changes in plans and improvements in methods.

Public Expenditures of Engineering Import Passed On by Voters

Public Improvement Projects in All Parts of U. S. Acted Upon by Electorate

APPROVAL of bond issues totaling more than $700,000,000 and consideration of many matters of policy affecting public works was requested of the voters of the country at the general election held Nov. 6. The largest single issue was that of the State of Iowa for $100,000,000 in highway bonds, which was approved, as were issues for the same purpose in Missouri, $75,000,000, and West Virginia, $35,000,000. Colorado and Pennsylvania turned down proposed highway bond issues amounting to $60,000,000 and $50,000,000, respectively. Louisiana approved road bonds for $30,000,000 and simultaneously imposed a 2c. gasoline tax for highway purposes. The state system of road control was adopted in Kansas, thus securing for the state continued reception of federal aid funds. Diversion of one-third of the receipts from the present gasoline tax to the counties was accomplished in Minnesota, despite the opposition of the three cities—Duluth, Minneapolis and St. Paul—which pay 39 per cent of the gasoline tax and 42 per cent of the motor car license fees.

Many of the eleven constitutional amendments submitted to the voters of Pennsylvania were of interest to the engineering profession, among them the proposal to make Pittsburgh a first-class city including the whole of Allegheny County under a federalized form of government preserving local autonomy in local matters, and the proposals to increase debt limits in Philadelphia and in all second-class cities. An opinion was also requested on bond issues of $50,000,000 for roads, $25,000,000 for reforestation, $8,000,000 for improvements at State College, $5,000,000 for improvements to various state institutions, and $5,000,000 for new state armories. All of these, without exception, were disapproved.

Municipal Issues

Results of the large number of municipal bond elections are to be found in the Construction News section of this issue. Chicago voted down proposed issues totaling $26,500,000 for the second time, apparently as a protest against the present administration. Louisville, Ky., and Detroit, Mich., approved expenditures of $10,000,000 for sewers and $5,000,000 for an airport, respectively. St. Paul, Minn., passed an issue of $7,577,000 for paving, street widening and

other municipal improvements. Akron, Ohio, will spend $12,530,000 for street improvements, grade-crossing eliminations, schools and water-works. Baltimore, Md., voted $10,000,000 for port improvements and $6,000,000 for the extension of Howard St. to relieve traffic congestion.

Pennsylvania Adds Forester to Highway Department

Reduced maintenance cost and not beautification of the highways is the primary reason for the transfer of John W. Keller, formerly nursery chief in the Pennsylvania Department of Forests and Waters, to the Department of Highways as a special engineer in charge of highway forestry, according to a statement issued by the highway department. It is expected that the proper use of evergreen trees as windbreaks will eliminate many miles of costly snow fences and that proper planting along the roadway will reduce damage by wind and flood.

Large Highway Contract Awarded by Costa Rica

An American firm will build a total of 135 miles of highway in the vicinity of San Jose, Costa Rica, at a total price of approximately $3,000,000, according to the terms of a contract recently awarded the Simmons Construction Corporation, Charlotte, N. C. Work is to start immediately and is to be completed in 30 months.

Arthur S. Tuttle to Be Consulting Engineer to City of New York

Arthur S. Tuttle, for the past eight years chief engineer of the Board of Estimate and Apportionment of the city of New York, has been appointed consulting engineer to the board, a newly created position. The change has been made to relieve Mr. Tuttle of administrative duty in order that he may devote his entire time to the broader aspects of the work which the city has in hand or in prospect. H. H. Smith, the present deputy chief engineer, has been appointed acting chief engineer.

Mr. Tuttle has been in the service of the city of New York since 1902, when he was appointed principal assistant engineer and subsequently deputy chief engineer of the Board of Estimate. Previous to that time, except for two years spent in Honolulu, he was in water-supply work in Brooklyn, first as a rodman upon graduation from New York University, and then as an assistant engineer.

Mr. Tuttle at numerous times has acted in a consulting capacity on water-supply work outside of the city of New York and has been active in engineering society affairs, having served as a director and as treasurer of the American Society of Civil Engineers and as president of the Municipal Engineers of the City of New York.

Two Rail Connections Authorized in West Virginia

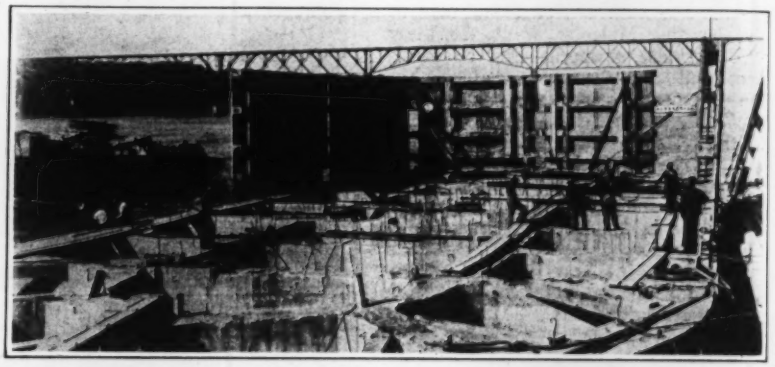
Construction of two new connecting lines in West Virginia has recently been authorized by the Interstate Commerce Commission. One of these will be built by the Nicholas, Fayette & Greenbrier Railroad from Swiss, Nicholas County, W. Va., a point on the New York Central, to a connection with the Loop & Lookout Railroad in Fayette County, a distance of 29 miles. The second road authorized will be built from Bryce to Beech Glenn, W. Va., by the Chesapeake & Ohio Railway, which is also granted trackage rights over the Kanawha & West Virginia Railroad from Beech Glenn to Swiss.

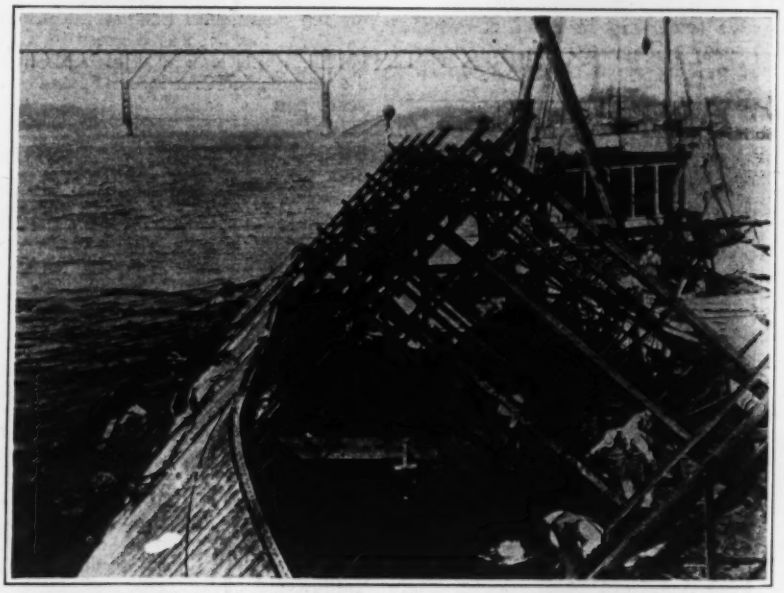
The new lines will open up a territory of approximately 230 square miles which is at present without railroad service. It is stated that this section contains many large tracts of merchantable timber and that it is underlain almost entirely by deposits of high-grade bituminous coal.

Rock Island Applies for New Extension for Subsidiary

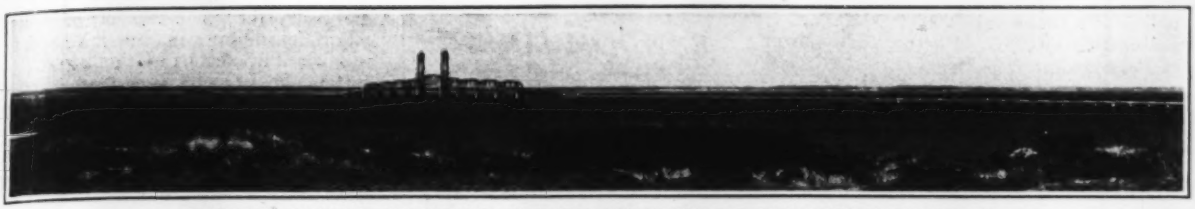
Application has been filed with the Interstate Commerce Commission by the Chicago, Rock Island & Pacific Railway and its subsidiary, the St. Paul & Kansas City Short Line Railroad, for permission to construct a new extension from Coburn to Birmingham, Mo., a distance of 84 miles. The new line will be built to avoid congestion between Trenton and Cameron Junction, and will connect at Birmingham with the Chicago, Burlington & Quincy Railroad, affording access to the railroad of the Kansas City Terminal Company.

SUCCESSFUL RIGHTING OF MID-HUDSON BRIDGE CAISSON





Two views taken before and after the righting of the east caisson of the Mid-Hudson bridge at Poughkeepsie, N. Y., which suddenly listed a year ago when sinking had just been started. It is an open dredging caisson 60x136 ft., built to a height of about 84 ft. at the time it listed. Since then the Blakeslee-Rollins Corporation, contractor for the piers, has been working energetically to right it. As the upper picture shows, this difficult task has been successfully accomplished, and the caisson is now being built up preparatory to sinking to final depth. The cutting edge is to go to 135 ft. below water; it is now down about 110 ft.



JAMES RIVER BRIDGE AT NEWPORT NEWS TO BE OPENED NOV. 17

Elaborate ceremonies at which Governor Byrd of Virginia will take an active part will mark the opening of the new James River highway bridge at Newport News, Nov. 17. The James River bridge, in connection with the recently opened Chuckatuck Creek and Nansemond River bridges and 10 miles of connecting concrete highway, will form an important link in the coastal highway system through the tidewater district of Virginia. Airplanes from Langley Field, the U.S.S. "Marblehead" and replicas of the "Monitor" and the "Merrimac" will take part in the bridge-opening program. The inspection parade will be led by the Richmond Blues, and President Coolidge at Washington will push a button to close the lift span, thus opening the bridge to traffic.

The James River bridge is 23,150 ft. long, mostly of concrete trestle construction with I-beam stringers. A 300-ft. vertical lift span and several plate girder and truss spans occupy the deep-water areas. The entire project was built by the Turner Construction Company for the James River Bridge Corporation in approximately thirteen months' time, with the Raymond Concrete Pile Company as sub-contractor.

Lavis to Head Central American Railways

Fred Lavis, consulting engineer, of New York, on Nov. 7 was elected president and member of the board of directors of the International Railways of Central America, succeeding Minor C. Keith, who was made chairman of the board. Mr. Lavis has had many years of experience in railway work, both in the tropics and in the United States, and is the author of a number of books on railway subjects. He has been at various times chief engineer of the Argentine Railway Company, consulting engineer to the government of Bolivia and consulting engineer to the American International Corporation, and has made examinations of railway projects and properties in Spain, Italy, South America and the United States.

During the past four years Mr. Lavis has been engaged in the design and construction of the special superhighway which the State of New Jersey has been building through Jersey City and Newark to connect with the Holland tunnel. His first connection with the properties which now form part of the International Railways was in 1911, when he made an examination of them for the National City Bank of New York. A general description of the railways as they then existed was published in *Engineering Record*, September, 1911.

Memphis Considering Increase in Building Heights

Revision of the building height limit in Memphis, Tenn., has been recommended by the City Planning Board following an investigation carried out at the suggestion of the Mayor. Inasmuch as the Mayor and a majority of the Councilmen are in favor of the change, its official adoption is expected in the near future. The revised regulation was drawn up and submitted to the planning committee by a sub-committee on zoning composed of three local architects appointed by the West Tennessee chapter of the American Institute of Architects in collaboration with Harland Bartholomew, consulting engineer of the planning commission.

The former height limit of 150 ft. at the building line is to be retained, but the new regulations will permit additional stories above this height provided these are set back from the street line at a ratio of 4 ft. additional height for each 1 ft. of setback, and also provided that the cubical contents of the building shall not exceed the volume of a prism having a base equal to the area of the lot and a height of 150 ft.

Reading to Electrify Lines in Philadelphia Suburban District

Three-Year Project to Cost About $20,000,000—Extensions Will Follow Later

ELECTRIFICATION of practically all main-line trackage of the Philadelphia & Reading Railway within the Philadelphia metropolitan district has been authorized by action of the board of directors. As approved, the work will be completed in three years at a cost of approximately $20,000,000 and will affect 49.9 miles of line and 110 miles of track. The lines to be electrified are on through routes in the vicinity of Philadelphia. While no official action has been taken, it is believed that the present progress is the first step in a complete plan which will include the New York division and the Schuylkill Valley branch to Reading and Pottsville.

Single-phase alternating current will be used at 11,000 volts. This will be collected by means of pantographs from overhead wires. Multiple-unit trains will be used to replace the present cars drawn by steam locomotives. At the same time the work of electrification is in progress, the company will install colored light signals in the place of the present semaphore signals. Bids on the preliminary work of electrification, as well as on the construction of 100 new coaches, will be asked for within the next two or three weeks.

Coolidge Dam Turbines Ordered

A contract has been awarded by the U. S. Indian Irrigation Service to the Pelton Water Wheel Company for two vertical reaction turbines for use at the Coolidge dam in Arizona. The turbines will be designed for a variable head of 140 to 220 ft., and will develop 9,200 hp. each. Moody spreading draft tubes will be used.

Court Upholds New York Water Tunnel Contract Award

The contract for the construction of all four sections of New York's new 18-mile water supply tunnel awarded by the Board of Water Supply to Patrick McGovern, Inc., for $42,692,567.50 was declared valid Nov. 8 by Supreme Court Justice Ingraham. The decision was in answer to a suit brought against the city by the Carleton Company, Inc., and the Del Balso Construction Company, low bidders on sections 224 and 225 of the tunnel, respectively, declaring the contract was illegally awarded. A temporary injunction preventing McGovern from starting work also was removed by the court. Notice of the award and suit was given in *Engineering News-Record*, Oct. 11 and 25, 1928, pp. 562 and 634.

Low bidders on each of the four sections were as follows: section 224, Carleton Company, Inc., $10,585,630; section 225, Del Balso Construction Company, $10,629,889; section 226, Patrick McGovern, Inc., $10,472,785; section 227, Patrick McGovern, Inc., $11,439,890. McGovern's bids on sections 224 and 225 were $11,427,987.50 and $11,151,905, respectively. The call for bids requested each bidder to state any reductions offered if two or more sections were awarded him. The following stipulations accompanied McGovern's bids: if sections 224 and 225 were awarded him, deduct $225,000 from each bid, or $450,000 from the total; if sections 226 and 227 were awarded him, also deduct $225,000 from each bid, or $450,000 from the total; if all four sections were awarded him, deduct an additional $225,000 from each

bid, or an additional $900,000, totaling a deduction of $1,800,000 from the total of the four sectional bids.

The lowest possible combination of bids was as follows: section 224, Carleton, $10,585,630; section 225, Del Balso, $10,629,889; sections 226 and 227, McGovern, $21,462,675, a total of $42,678,194 for the entire tunnel, or $14,373.50 over the McGovern company's bid for four sections.

The Board of Water Supply, using its discretionary powers permitted by law, declared the Carleton Company unqualified to handle a contract for one section of the tunnel. As the next low bid for section 224 was $11,260,860, this made McGovern's bid on all four sections low by $660,873.50. The court upheld the action of the board in refusing to consider the Carleton Company's bid. The board's demand of a certified check for $400,000 to accompany each bid on each section was held legal by the court in answer to the plaintiff's objections.

Engineering Council Gives Views on Proposed Legislation

At a meeting of the American Engineering Council held Oct. 19 at Pittsburgh, Pa., the position of the council was defined upon a number of measures of national legislation now on the calendar. The council expressed its approval of the proposed hydraulic laboratory of the Bureau of Standards, of the principle of the accelerated expenditure of federal funds on public works in times of depression, of the proposal to give a permanent status to the present Mississippi River Advisory Commission, of the unification of certain features of government contracts, of the proposed inventory of water resources throughout the United States, of the proposition to transfer all public works to the Department of the Interior, and of the proposed bill to complete the mapping of the Mississippi Valley. It opposed the proposed national employment bureau as being an unnecessary expenditure inasmuch as many states now have their own employment bureaus, and other states have refrained from establishing these for sufficient reasons. The plan to lend engineers of the U. S. Bureau of Public Roads to assist governments of various Latin American republics was disapproved on the ground that it involves the appropriation of federal funds for the benefit of foreign countries and permits double payment of salaries to certain federal employees. The transfer of the Geodesy Division from the Coast and Geodetic to the Geological Survey was also disapproved as being of no practical value and of having the disadvantage of destroying the effect of an enviable prestige both nationally and internationally. No action was taken on a bill providing for federal and state co-operation in the protection of valuable land from erosion, on the ground that this would fall within the province of the new hydraulic laboratory already mentioned.

RANDOM LINES

The Blot

By Elldee

The blot's a drafting-room mistake that forms a puddle, pond or lake upon the tracing, when the mug—or bottle, jardinière or jug—that holds the draftsman's ink, somehow gets upset on same—meeow! to make the rooster tear his kelp and hop around and yodel "HELP!"

To get a blot upon one's sheet, when he has squirmed with prickly heat bent double on his trusty stool and toiled with compass, pen and rule day in, day out, for months perhaps, 'twixt moans and cusses, groans and gaps, to get a "perfect" drawing out, makes him as crazy as a trout!

Ah, well do we recall one day—'twas on the 39th of May—when, after six long weeks of work with slide rule, angle, pen and dirk, upon the floor plan of a cheese, we straightened up with heartfelt wheeze and viewed our masterpiece at last—complete! A work of art! Dodgast!

An then—odds Higgin's! raised our mitt, to brush the art gum crumbs off it, and quicker than a jaybird's wink kerplunked a beaker full of ink smack on the tracing's gleaming face, to flop and roll from place to place ere we could snare it with our square and give it what is called "the air"!

This is the reason draftsmen's hay so early falls out or turns gray; the explanation of the fact that 88 per cent are cracked; why nine in almost every ten land in the poorhouse or the pen! (Which figures, though, we won't vouch for; but anyway, blots make one sore!)

WASHINGTON NOTES

By Paul Wooton
Washington Correspondent

Flowage Right Payments—Oil Rights in Western Rivers—Local Conditions and the Contractor

IN THE controversy over the question of flowage rights in connection with the Mississippi flood-control project, the Chief of Engineers has made it clear that payments for flowage will not be made except where additional destructive flood waters are diverted from the main channel of the Mississippi River. In view of the wording of the law and the engineering facts in the case, General Jadwin holds section 4 of the act does not provide for payments in such places as the Atchafalaya basin, where it is not proposed to divert any water from the main channel of the Mississippi. Owners of the land within the floodways are being told that the existing law does not permit payment for flowage and are being asked to name the price they will accept to waive claims for flowage in case it should be authorized by new legislation.

Difficulty is being experienced in securing prices on the land required for the Bonnet Carré spillway which are satisfactory to the army engineers. Some delay to that project already has resulted. The engineers take the position that they should not temporize with a situation which will postpone protection against floods. For this reason none will be surprised to see condemnation proceedings begun in the near future. A special provision in the flood-control act stipulates that the land required for project works may be taken over and used pending the outcome of litigation as to price.

Mapping of U. S. Lags

Four years have passed since the Temple act was passed to provide funds for rapidly completing the topographic map of the United States, and still the work drags on awaiting action to make the money available. Instead of following the plain intent of Congress as expressed in the act, the Bureau of the Budget and the House Committee on Appropriations have seen fit to accept only one minor provision which authorizes co-operative agreements with states or civic subdivisions "for the purpose of expediting the completion of the mapping." The very essence of the legislation has oozed through this loophole, it is pointed out, reducing the residue to the same impotent condition of many other enactments. The word "expediting" is interpreted in some obscure secondary meaning while 57 per cent of this nation's area remains unmapped.

It was the will of Congress that the survey should be carried out within a twenty-year period, to which end $750,000 was to be used for topography and $200,000 for control during the first year, leading up in five years to a maximum of $2,000,000 for topography and $400,000 for control. After running twelve years on essentially the same basis, the schedule of appropriations was to have gradually decreased as the original surveys were completed. In 1927, $510,200 was allocated to topography; $505,000 in 1928, a sorry contrast to the intended program. Under these conditions, the United States remains one of the last among civilized countries to realize upon the benefits of a complete and accurate mapping system.

Riverbed Oil Lands

Following a conflict in authority between the federal government and the State of Utah in the matter of oil permits along the Green, Colorado and San Juan rivers, Supreme Court action has been initiated by the United States to quiet the title to certain portions of the beds of these rivers within Utah. Ownership hinges upon navigability. If a stretch of river within a state is navigable, the state has jurisdiction of the bed up to the ordinary high-water mark. Otherwise the riparian owners control, usually to the middle of the

stream. The U. S. government is riparian owner and asserts title on the assumption that the streams are not now and never have been navigable in fact or within the meaning of the laws of the United States. It is understood that federal investigations have been made in the field to establish grounds for this contention. Apparently simple cases of this nature are involved by the question of what tests of navigability are to be applied.

No power or storage projects are being considered along the portions of river under litigation. Therefore it is believed that the decision will have a practical effect only on oil and possibly mineral interests. Inasmuch as such cases apply only to the section of river directly involved and are tried separately on basis of fact, there will be no bearing on the Boulder Dam project except indirectly by the establishment of another link in the chain of precedent.

European Hydraulic Laboratories

From data gathered so far during a European inspection tour by two of its officers, the Corps of Engineers believes its opinion is confirmed that a hydraulic laboratory should be under the direct supervision of engineers in charge of the field work. Col. E. M. Markham and Lieut. J. P. Dean, who have been making a tour of hydraulic laboratories in Europe, have nearly finished their studies and will return soon to Washington.

Most of the laboratories in Europe, it has been found, are being operated by the large universities. While impressed with the possibilities of such laboratories, the engineer officers report that they believe better results could be obtained through unified direction of research work and actual operations. It has been pointed out also that because of the relatively smaller size of the European countries hydraulic laboratories, though remotely situated from the field of operations, are more accessible than they would be under similar conditions in this country.

"Foreign" Contractors Overlook Local Conditions

That the outside bidder would not constitute such a problem in the construction field if he had a better knowledge of local conditions has long been realized, it is stated at the office of the Associated General Contractors. Plans are being worked out, therefore, for the institution of an educational campaign in the industry with the object of convincing the "foreign" contractor that his best interests would be served by affiliating himself with local contractor organizations before submitting his bid. It is pointed out that in this manner the outside bidder would be able to gain a better knowledge of actual conditions. In many cases, it is believed, this knowledge would prevent unscientific bidding, which, if approved, would be as harmful to the bidder as to the contracting industry generally, to say nothing about the effect it would have on those responsible for the project.

Engineering Societies

CALENDAR

Annual Meetings

AMERICAN ROAD BUILDERS' ASSOCIATION, Washington, D. C.; annual convention, Cleveland, Ohio, Jan. 14-18.

AMERICAN SOCIETY OF CIVIL ENGINEERS, New York, N. Y.; annual meeting, New York, N. Y., Jan. 16-18.

THE NATIONAL COUNCIL OF STATE BOARDS OF ENGINEERING EXAMINERS' annual convention is to be held at Little Rock, Ark., Nov. 19 and 20. T. Keith Legare, Columbia, S. C., is secretary.

THE AMERICAN RAILWAY ENGINEERING ASSOCIATION board of directors will meet in New York City Nov. 20. Simultaneously a meeting of the engineering division of the American Railway Association will be held.

THE COLORADO ENGINEERING COUNCIL at its Nov. 6 meeting heard Dana E. Kepner, state sanitary engineer, speak on "Swimming Pool Sanitation."

THE BOSTON SOCIETY OF CIVIL ENGINEERS will meet on the evening of Nov. 21 in Tremont Temple to participate in a symposium on "Engineering Geology as Applied to Water Tunnels," with particular reference to the 14-mile tunnel now under construction near the Wachusett reservoir. Speakers will be F. E. Winsor, chief engineer, W. W. Peabody, division engineer, F. E. Fahlquist, assistant engineer, all of the Metropolitan District Water Supply Commission; C. P. Berkey, Columbia University; Prof. F. K. Morris and Prof. Charles Terzaghi, Massachusetts Institute of Technology.

Personal Notes

F. W. SCHEIDENHELM, consulting engineer, New York, has been awarded the Distinguished Service Medal for his services in water-supply work on the staff of the Chief Engineer of the American Expeditionary Forces in France, with the 26th Engineers and with the First Army after it was organized. In the latter work he was charged with the responsibility for reconnoissance, design and construction of the army's water supplies.

GEORGE E. EVANS, for 31 years manager of the Ontario division of the Dominion Bridge Company, Montreal, has retired and will remain with the company in an advisory capacity. He is succeeded by A. Ross ROBERTSON.

STEWART S. NEFF, of Philadelphia, Pa., who was recently appointed general superintendent of the Gledhill Construction Company, a subsidiary of the National Surety Company, has been transferred from Buffalo, N. Y., where he has just completed two high school buildings, to Atlanta, Ga., where he will be in charge of all construction and contracts of the company. Prior to his present engagement Mr. Neff was with the Feather River Power Company and the Los Angeles Flood-Control District in California.

JOSEPH L. HARRIS, field engineer for the Sexton Corporation, Mineola, L. I., has been placed in charge of a branch office recently opened by the firm in Houston, Tex.

HENRY S. GIERLICH, city engineer of Monrovia, Calif., has been elected president of the City and County Engineers' Association, which includes more than 200 municipal and county engineers in Los Angeles County.

T. C. SCHAETZLE, for the past five years senior assistant sanitary engineer with the Maryland State Department of Health, has resigned to become superintendent-chemist of the sewage-treatment works at Akron, Ohio.

JESSE K. GIESEY, who served as city engineer of York, Pa., during 1927, is now resident engineer for Pearse, Greeley & Hansen, of Chicago, on intercepting sewers and sewage-treatment works for the Sanitary District of Rockford, Ill.

H. W. BUSH, Warsaw, N. Y., has been appointed a bridge designer in the offices of the Kentucky State Highway Department, succeeding NED WILLIAMS, who has accepted a position with the Wyoming Highway Department.

Obituary

RUFUS T. GENT, general superintendent of the New York Trap Rock Corporation, died of pneumonia at Newburgh, N. Y., Oct. 4. He was born in Rockford, Ill., April 6, 1879. At the age of seventeen he began to work with the Lewiston & Youngstown Railway at Niagara Falls, N. Y., leaving this to enter the engineering training force of the Westinghouse Electric & Manufacturing Company at Pittsburgh. In 1904 he became plant engineer for the United Engineering Company on the construction of the Pennsylvania Railroad tunnel at New York City, the New York State barge canal, power plants in Cuba and South America and the Mount Royal tunnel at Montreal. In 1914 he became plant engineer for the Hydro-electric Power Commission of Canada, working on the Chippewa power project. After completing this, he accepted the position of general superintendent for the New York Trap Rock Company in 1919. During his nine years of service the company's production increased from 600,000 tons to 5,000,000 tons annually. Mr. Gent was a member of the American Society of Mechanical Engineers and the Canadian Society of Electrical Engineers.

Construction Equipment and Materials

National Equipment Acquires Parsons and Insley

Announcement has been made by Philip A. Koehring, president of the National Equipment Corporation, of the acquisition by that company of the Parsons Company, Newton, Iowa, manufacturer of power trench excavators, and of the Insley Minufacturing Company, Indianapolis, Ind., manufacturer of steel towers for hoisting and pouring concrete. The corporation also controls the T. L. Smith Company, Milwaukee, Wis., manufacturer of concrete mixers, as was announced a short time ago, and the Koehring Company, the initial unit of the corporation.

The National Equipment Corporation was organized in 1927 by Philip A. Koehring and associates to acquire the ownership of companies manufacturing construction machinery. Its organization is modeled on that of the General Motors Corporation, the divisions being operated as independent units with close co-operation in engineering matters, standardization of production methods, warehousing, service and other angles where savings can best be realized. Headquarters of the corporation are located in Milwaukee, which is also the site of both the T. L. Smith and Koehring plants. It is stated that the corporation as now constituted has total assets of approximately $9,000,000 and that 1928 sales will be close to $10,000,000. Products of the member concerns are sold in every state of the Union and in many foreign countries.

The two new acquisitions will continue under their present management as divisions of the National Equipment Corporation. H. C. McCardell, president of the Parsons Company, and W. H. Insley, president of the Insley Manufacturing Company, will become vice-presidents and directors of the parent corporation.

Snow Removal Facilitated by Improved Equipment

Reports received by the U. S. Bureau of Public Roads indicate that during the winter of 1927-28, 111,645 miles of main highways were cleared of snow in 36 states. The practice of removing snow from highways was begun in the winter of 1921-22, and since that time there has been a steady improvement in machines and equipment available. During these six years the use of truck plows has grown from 184 to 3,412; the number of tractor plows from 281 to 1,275. During the past season less than half the number of graders were used as in the preceding year, indicating that the grader has been found less effective than the truck and tractor plows. All snow-removal work was done under state supervision in seventeen of the states reporting. In fifteen, the work was done by both state and county or other local governments. Four states reported that all work was under local control.

Concrete Paving Awards

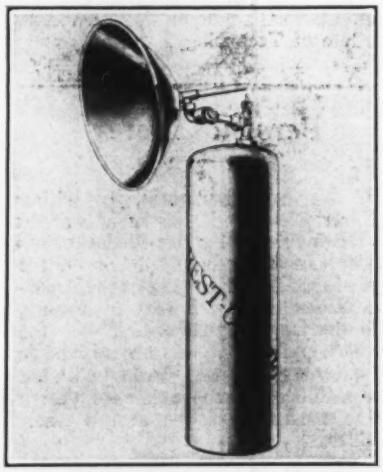
The table below, prepared by the Portland Cement Association, summarizes the contracts let during October and during the calendar year up to Oct. 27 for concrete paving work in the classifications listed:

	Sq. Yd. Awarded in October, 1928	Sq. Yd. Awarded Jan. 1, 1928, to Oct. 27, 1928
Roads	3,856,370	83,152,989
Streets	2,756,146	44,979,033
Alleys	455,764	3,436,282
Total	7,068,280	131,568,304

New Developments

Floodlight Attachment for Acetylene Tanks

The use of small tanks of dissolved acetylene, already familiar for truck and tractor lighting, for floodlighting on



night construction is made possible by a new attachment brought out by the Prest-O-Lite Company, Inc., 30 East 42d St., New York City. A 10-in. reflector and a burner are fastened to the standard tank connection by means of a knurled nut. Universal adjustment is obtained by a single swing joint. The attachment itself makes a convenient handle for carrying the entire assembly from one portion of the job to another. It is intended to be used with the standard Prest-O-Lite tanks produced by the same company, which are available in service stations throughout the country.

Lightness and Safety Features of New Rivet Buster

A pneumatic hammer specially designed for removing rivet heads up to ¾ in. in size and containing new design features which increase safety and reduce weight has been announced by the Ingersoll-Rand Company, New York City. The nozzle end of the rivet buster is finished with a heavy square-section thread over which a retainer nut screws. Three different tools are furnished for use with the machine, a cutting chisel, a shearing chisel and a knock-out punch. These are made with a knob at the upper end, permitting the use of lightweight tools, as the shank is not weakened by the usual notches or grooves. The knob provides a shoulder for transmitting the blow through a split nozzle to a rubber bumper and on to the retainer nut in cases when the hammer is operated without having the tool held against the work. This makes it impossible for the tool to be shot out of the hammer and gives absolute safety.

Size of Chain Drives Stocked Is Increased to 60 Hp.

It is now possible to obtain for delivery from stock chain drives in practically any reduction from 1 to 1 to 7 to 1 with capacities as high as 60 hp., according to an announcement recently made by the Link-Belt Company, Chicago, Ill. Formerly all chains above 15 hp. have been strictly an engineering problem, each installation being considered as a unit. The company has issued a catalog listing all types of drives immediately available.

Belt Slippage Reduced by Plastic Pulley Coating

Increased production from belt-driven units, secured by reducing the slippage in the belt, is claimed by the manufacturers of Pulleystone, a plastic material which is spread over the belt pulley by hand. The manufacturer, the Chicago Belting Company, Chicago, Ill., states that the material is equally applicable to iron, steel or wood pulleys using belts of leather, rubber or canvas. Pulleystone is marketed in 20-lb. cans.

Business Notes

ATLANTIC GYPSUM PRODUCTS COMPANY and Canada Cement Company, Ltd., have formed an arrangement by which all the crude gypsum rock from Nova Scotia used by the two companies will be produced by the Atlantic Gypsum Products Company, instead of separately as at present. In addition, the Canada Cement Company, Ltd., retires as a manufacturer of gypsum products in the United States through the sale of its Pennsylvania Gypsum Company plant at Chester, Pa., to the Atlantic company.

TRACKSON COMPANY, Milwaukee, Wis., has appointed the following distributors: Motor Power Equipment Company, St. Paul, Minn.; Industrial Tractor Sales Company, Baltimore, Md.; E. B. Kelly Company, Albany, N. Y.; W. B. May, Inc., Buffalo, N. Y.; Truck-Tractor Equipment Company, Columbus, Ohio; Tractor & Equipment Company, Newark, N. J., and Service Supply Company, Philadelphia, Pa.

CLINCH-MITCHELL CONSTRUCTION COMPANY, Chicago, Ill., has been organized, succeeding the Flick Construction Company, of the same city. The new company will engage in general railway contracting and will have the same policy and the same officers as the old organization.

FREDERICK KENT COPELAND, president of the Sullivan Machinery Company since 1892, died at Claremont, N. H., Nov. 10, while on a visit to the company's Eastern works. He was born in Lexington, Mass., and was graduated from the Massachusetts Institute of Technology in 1876. After several years spent in Iowa and Colorado in mining engineering work, he helped organize the Diamond Prospecting Company in 1884 and became its president. This company engaged in contracting with the Diamond Core Drills made at Claremont, N. H., by the Sullivan Machine Company. In 1892 the two companies were merged, with Mr. Copeland as president. Under his leadership Sullivan products were developed for a wide range of purposes, serving the mining, quarrying, construction and manufacturing industries, manufactured at plants at Claremont, N. H., and Michigan City, Ind., and a world-wide sales organization was built up. Mr. Copeland maintained active leadership up to the date of his final illness. He was a member of numerous engineering societies, including the American Institute of Mining and Metallurgical Engineers, the American Society of Mechanical Engineers and the New York Engineers' Club, and was a past-president of the Engineers' Club of Chicago, of the Western Society of Engineers and of the National Metal Trades Association. He had served as a trustee of the Massachusetts Institute of Technology and, in earlier years, as a trustee on the village board of Winnetka, Ill.

POWER SHOVEL EXHAUSTS THROUGH FLEXIBLE TUBE

Use of a motor-driven power shovel for excavating underground has been successfully accomplished in the construction of the Brooklyn subway by leading the exhaust gases from the motor to the outer air through a flexible tubing. This illustration, furnished by the Universal Power Shovel Company, Detroit, Mich., shows one of that company's machines at work excavating a stiff clay. The Johnson Construction Corporation has had two of these units in use for several months with complete success, reporting that no bad effects have been noticed from the fumes of the motor. The machines were lowered into the subway in sections and assembled on the lower level. It is reported that the two shovels average 225 cu.yd. per eight-hour shift in this type of digging.

Manufacturers and Trade Associations

CALENDAR

ANNUAL MEETINGS

NATIONAL SAND AND GRAVEL ASSOCIATION, Washington, D. C.; annual convention, Cleveland, Ohio, Jan. 9-11, 1929.

AMERICAN ROAD BUILDERS ASSOCIATION, Washington, D. C.; annual convention, Cleveland, Ohio, Jan. 14-18, 1929.

NATIONAL CRUSHED STONE ASSOCIATION, Washington, D. C.; annual convention, Cleveland, Ohio, Jan. 21-24, 1929.

New Publications

Surge Tanks — CHICAGO BRIDGE & IRON WORKS, Chicago, Ill., has issued a 20-page illustrated booklet devoted to the Johnson differential surge tanks manufactured by this company. Photographs showing a number of typical installations are shown. The book discusses the development of surge tanks, their function and structural features, and the advantages of the differential principle as applied to tanks.

Snow Removal Equipment — GOOD ROADS MACHINERY COMPANY, INC., Kennett Square, Pa., devotes a 56-page illustrated booklet to describing all models and sizes of its snow plows for truck and trailer attachment. The sand spreader manufactured by the company is also described.

Culverts—ARMCO CULVERT MANUFACTURERS ASSOCIATION, Middletown, Ohio, discusses the economic advantages of various types of culverts in a bulletin entitled "Selecting Culverts and Drains on the Basis of Cost Per Year." The text discussion is clarified by a number of charts and tables and is well illustrated.

Air Compressor Standards — THE COMPRESSED AIR SOCIETY, New York, N. Y., has issued the third edition of its trade standard pamphlet, containing 47 pages, numerous illustrations and tables. New material which has been added includes a description of the A.S.M.E. standard air receivers, pneumatic tool standards, a section on portable compressors and additional information relating to the installation and care of compressors.

Pump Standards — THE HYDRAULIC SOCIETY, New York, N. Y., has issued the fifth edition of its "Standards." The principal changes from the preceding edition are a revision of the extracts taken from the A.S.M.E. test code for centrifugal and rotary pumps and changes in materials recommended for the construction of special service pumps to conform with the latest accepted practice. The new edition contains 80 pages and many illustrations and charts.

The Business Side of Construction

American Labor Shares in Production Profits

The United States Census Bureau is gradually making public its census of American manufacturing industries which was taken at the opening of the current year. Several interesting and significant trends are disclosed by these figures when taken in conjunction with the data gathered in the previous census taken at the opening of 1926.

There is an undoubted trend toward the concentration of productive operations. The 74 industrial groups so far reported indicate a decrease in number of manufacturing plants in these groups of 2.6 per cent since 1925. If this percentage of decrease holds for all industries when the figures for all industries are available, it will mean a decrease of about 4,900 manufacturing plants during this two-year period. Going back to 1919, the decrease in number of manufacturing plants will total about 31,100 since the war. The normal annual growth in volume of products produced is about 4 per cent. Since the war, therefore, the volume of goods manufactured has probably increased by about 30 per cent, while the number of plants in which these products are produced has decreased by 14 per cent.

There has also evidently been a reduction in the number of wage earners in manufacturing plants. From 1925 to the end of 1927 this reduction was around 0.6 per cent, which would indicate a total number of wage earners in manufacturing plants at the close of 1927 of 8,330,000, or a reduction of 660,000 since the close of the war. The answer to the present high rate of general employment in the face of this material reduction in factory employment during the past eight years lies in the very material increase in the number employed in occupations other than manufacturing — the so-called "public service occupations."

E. N.-R. Index Numbers

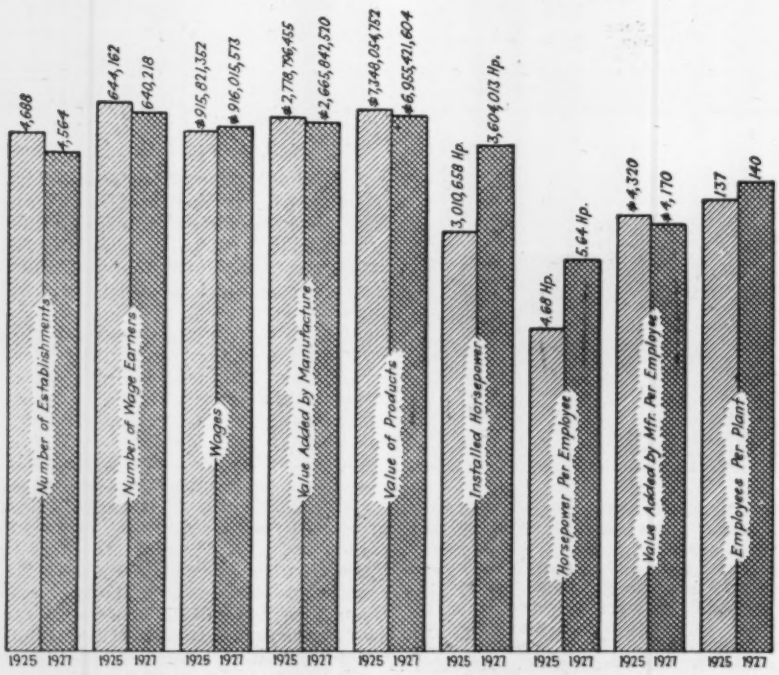
Cost		Volume	
Nov. 1, 1928	**209.46**	**October, 1928**	**383**
Oct. 1, 1928	207.71	September, 1928	296
Nov. 1, 1927	201.98	October, 1927	269
Average, 1927	206.24	Average, 1927	263
Average, 1926	208.03	Average, 1926	228
1913.....	100.00	1913.....	100

The favorable financial condition in which the American laboring man finds himself today is clearly pictured by the data on wages. The groups for which data are available indicate that the average amount of wages received per employee in 1927 was about $1,432, as against $1,164 in 1919, an increase of 23 per cent. This fact is even more striking when it is remembered that the cost of living since the war has actually declined by 6 per cent and is 21 per cent under the peak of 1920. In other words, not only does the average employee in American manufacturing plants receive substantially more wages than eight years ago but the amount of commodities which he can purchase with each dollar of these wages has also very materially increased.

Another significant fact brought out by these advance figures is that in 1927 the average employee added $4,170 to the value of the raw products used in manufacture, while in 1919 the value added per employee was only $2,750—that is, through more efficient machinery, better organization and more intelligent workmanship on the part of the wage earner, each employee has increased the value which he has added to manufacture by 52 per cent.

In the resultant of these two statements is to be found one of the basic influences underlying the present prosperity of American industry. The American laborer has fully shared in the results of his efforts. He has increased his productive value to his employer by 52 per cent, and his employer has in turn increased the employees' wages by 23 per cent, even in the face of a declining cost of living. American labor has shared very fully in the increased increment to the manufacturer, and in this sharing of profits the nation has exhibited a fundamental in the relationship between capital and labor which is not shared in European countries.

One of the basic reasons for this increased value of products produced per employee and resulting in increased wages per employee is the materially increased use of power per employee. In 1927, according to the incomplete figures, there was a total of 5.63 hp. installed per employee, as against 3.26 hp. in 1919, or an increase of about 73 per cent in the use of power per employee in manufacturing plants.



THE TREND TOWARD GREATER USE OF POWER AND CONCENTRATION CONTINUES IN AMERICAN INDUSTRY

High Manufacturing Operations Continue

The second month of the fall season witnessed a rate of general operations in the manufacturing plants of the nation as a whole on an unusually high plane but on a plane slightly below that witnessed during September. October rate of operations was about 1.9 per cent under September but was 10.1 per cent over October last year. It appears that the peak of industrial activity for 1928 was recorded in September and that the remaining months of the year will witness a gradual drop in the rate of activity, though there is every reason to expect that general operations will continue on a compartively high plane at least until the opening of the spring months.

This Week's Contracts

Heavy construction contracts, reported by *Engineering News-Record* in the week ended Nov. 13, with some comparisons, total as follows:

(In Thousands of Dollars)

	Nov. 13, 1928	Nov. 5, 1928	Nov. 15, 1927
Buildings:			
Industrial.....	$5,905	$6,502	$4,558
Commercial.....	31,334	25,953	27,119
Streets and roads..	10,872	5,217	9,833
Other construction.	60,833	13,834	7,243
Total.....	$108,944	$51,506	$48,753
Total, all classes, Jan. 1 to Nov 13:			
1928.....			$3,268,409
1927.....			2,826,707